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SEVENTH ANNUAL REPORT
OF THE
METROPOLITAN SEWERAGE COMMISSION

1896

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Pumping Station at Charlestown
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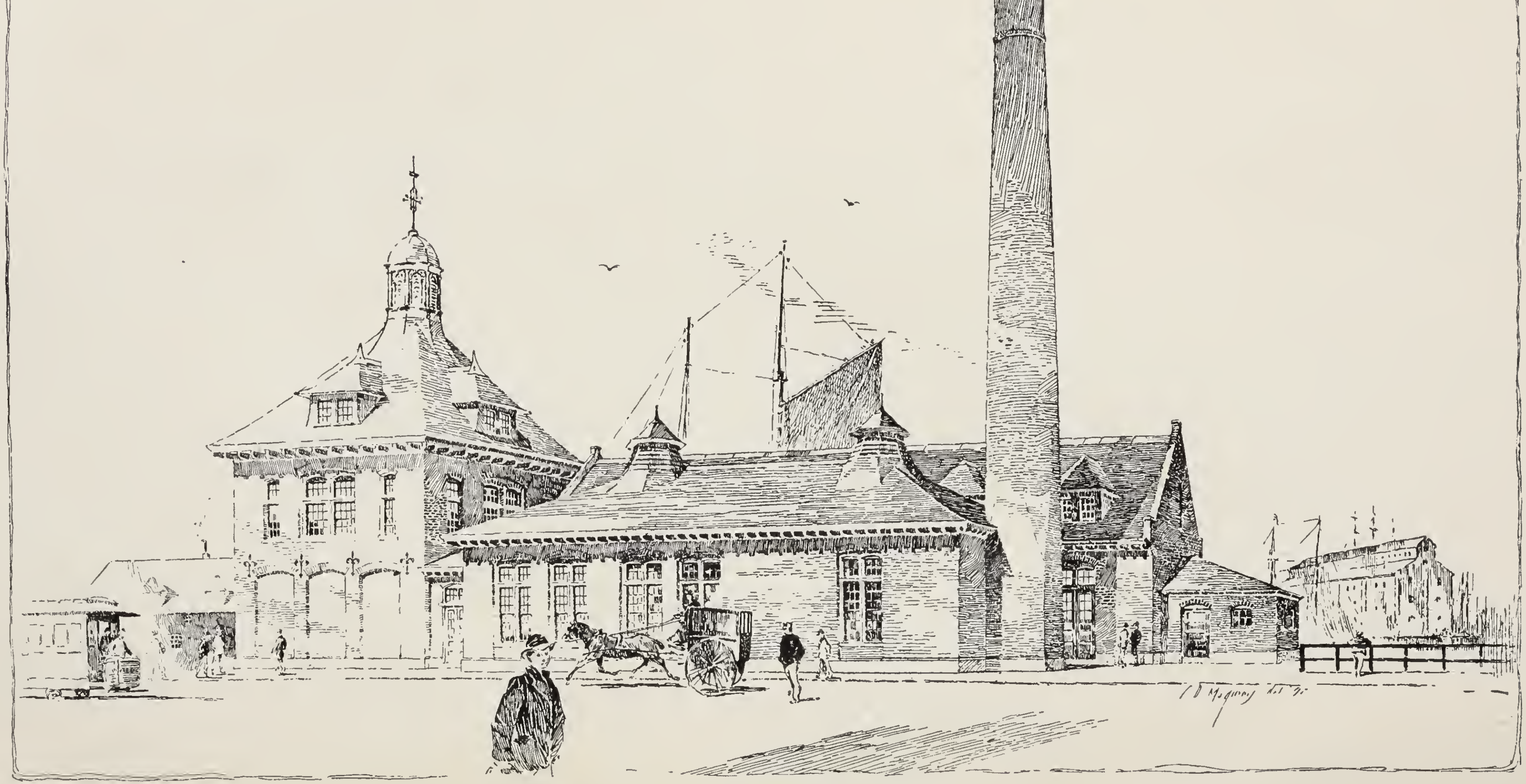

. . . COMPLIMENTS OF . . .

Metropolitan Sewerage Commissioners

OF MASSACHUSETTS.

HOSEA KINGMAN,
TILLY HAYNES,
ALBERT F. NOYES,
Commissioners.

EDWARD P. FISK, Clerk.

WILLIAM M. BROWN, Jr.,
Chief Engineer and Superintendent.

WILLIAM D. TURNER, Attorney.

110 BOYLSTON STREET,

BOSTON.

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SEVENTH ANNUAL REPORT

OF THE

BOARD

OF

METROPOLITAN SEWERAGE COMMISSIONERS,

FOR THE

YEAR ENDING SEPTEMBER 30, 1895.

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6th ed.

Sept 24, 1899

Commonwealth of Massachusetts.

To the Honorable the Senate and the House of Representatives.

The Board of Metropolitan Sewerage Commissioners, created by chapter 439, Acts of 1889, presents its annual report, which is the seventh since its organization, and covers the year ending Sept. 30, 1895.

In our report for last year (Public Document No. 45, 1895), upon the general condition of the work intrusted to us, we said: —

> The main line of the north metropolitan system from its extreme northern point in Stoneham has been completed to the outlet at Deer Island, excepting small gaps at Malden River, Belle Isle Inlet, the extreme end of the outlet itself, and the pumping stations, all of which are now in process of construction. Work on branches is progressing on Eastern Avenue, Chelsea, in East Boston, Charlestown and Somerville, along the line of the Mystic River. The branch extending through Everett, Malden and Melrose to Stoneham, and also that in Winchester and Woburn, designed to relieve Cummingsville, are practically complete. The two branches extending into Somerville and Cambridge, the one following the general line of Alewife Brook and the other extending through the eastern portion of said cities, lack the completion of the siphons under Mystic River and the construction of the pumping stations to render them available, upon the completion of the main line.
>
> . . . .
>
> The Charles River system has been in operation during the year, and numerous connections have been made therewith by the towns and cities thereon. A list of these, and also a table showing the cost of operating this system, are submitted herewith.

At the time of our first annual report, dated Sept. 30, 1889, the Board had just organized, and the matter of the appointment of an engineer was receiving attention. A chief engineer was appointed during the latter part of October, 1889, and assistants during the following month. During the winter and spring of 1889–90 surveys and studies were made on Deer Island, in Winthrop, in East Boston and in the lower part of the Charles River valley.

The work of construction was begun at the lower ends of the north metropolitan and of the Charles River valley systems in May and June, 1890, four and one-third years ago. By September 30 work was in progress at various points from Huntington Avenue, Boston, to Waverly Street, Brighton, and from the middle of Deer Island to Chelsea River, excepting the siphons and pumping stations.

At the time of our second annual report, Sept. 30, 1891, that portion of the main line (north metropolitan system) extending from near the southerly end of Deer Island, through Winthrop, East Boston, Chelsea, Everett and Medford, to near Medford Square, was nearly one-half completed, and the balance, except the siphons and pumping stations and a part of the sewer in Chelsea, was under construction. Work was also begun at the lower ends of the Cambridge and Melrose branches. The wharf at Deer Island was completed during the winter.

All of the Charles River line from Huntington Avenue, Boston, through Brookline, Brighton, Newton, Watertown and into Waltham, was under construction, and three-fourths of it was completed.

On Sept. 30, 1892 (date of our third annual report), work on the main sewer of the north metropolitan system had been pushed nearly to the lower Mystic Lake in West Medford, and, excepting the siphons, pumping stations and outfall, a comparatively small portion of the main line remained to be done. Work on the siphon at Chelsea River was commenced that year. The remaining part of the Melrose branch, and the Cambridge branch as far as Main Street, Cambridge, were put under construction, except the siphon and pumping station at Mystic River.

The Charles River valley system was completed during the winter of 1891–92, and was put into operation early in the spring of 1892.

On Sept. 30, 1893 (date of our fourth annual report), construction had been commenced at various points on the main line from near the lower Mystic Lake to the extreme upper end in Stoneham, the entire Alewife Brook line (except the siphon and pumping station), the balance of the Cambridge branch and the lower part of the East Boston branch.

Owing to the difficult and costly work which the outfall and various siphons promised to be, and because of the risks and uncertainties attendant thereon and the liability of change of plans to meet varying conditions, it was deemed wise to have the construction carried on under the immediate direction of the engineering department, instead of by contract. The siphon at Belle Isle Inlet had been let by contract before this determination was arrived at. Accordingly work on the outfall at Deer Island and the siphons at Shirley Gut and Mystic River was entered upon. The siphon at Chelsea River, which was started at the close of the previous year, was pushed to completion, as was also the deeper part of the Shirley Gut siphon. Day work of less magnitude was also entered upon at three other localities.

During the year ending Sept. 30, 1894, work by contract was commenced and prosecuted in the following localities: from Marginal Street through Eastern Avenue, Chelsea; through and around the borders of East Boston; around the southerly and easterly sides of Charlestown; through Mystic Avenue, Somerville; and the Cummingsville branch, in Winchester.

The contractors who were building the pumping-station houses at Deer Island and East Boston had nearly completed their work. The engine and boiler house for the Charlestown station had just been commenced. Day work on the foundations and connections at Deer Island and East Boston pumping stations was commenced this year, nearly completed, and that on the Charlestown station was well advanced. The important work on the outfall and siphons started last year was continued. The siphons at Malden River, Abbajona River and the upper Mystic River were commenced, and were built by day work, for the reasons mentioned in the sketch of the work for 1893. The only portions of the entire system not then completed or under actual construction were the small pumping station for the Alewife Brook line and three spurs on the same line, covering a total distance of about 1,700 feet. Studies and plans had been made for doing that work.

The past year has witnessed the practical completion and opening of the north metropolitan line to the towns and cities for whose benefit it was constructed. On May 27 official notice was given to the authorities of the towns of Arlington, Belmont, Melrose and Winthrop, with the cities of Chelsea, Everett, Malden and Medford, and also so far as the Alewife Brook line was concerned to the cities of Cambridge and Somerville, that on and after June 1 they would be permitted to discharge into the metropolitan sewer sewage of a character satisfactory to the Board, through any properly authorized connection.

June 29 a similar notice was sent to the sewer commissioners of the town of Winchester, stating that on and after July 1, 1895, the low-level metropolitan sewer in their town would be in operation and ready to receive sewage. The city of Woburn having obtained permission to temporarily use that portion of the Mystic valley sewer within its limits not included within the taking and purchase of said sewer made by this Board, was granted a temporary connection on July 18, at the point where our taking terminated. On September 9 the cities of Boston, Cambridge and Somerville were notified that they would be permitted, on and after September 23, to discharge sewage into the metropolitan sewer at any authorized connection within their limits. This practically opens the entire north metropolitan system to the towns and cities embraced within its limits, and nearly all of them have connected their local sewers at one or more points, and availed themselves of this method of disposing of sewage.

In the report (fourth annual) for the year ending Sept. 30, 1892, the completion of the Charles River valley system was announced by this Board. The said system has been continually operated since then, so that to-day (Oct. 1, 1895) the systems of sewage disposal authorized by chapter 439, Acts of 1889, are in operation and receiving sewage from the cities and towns for whose relief they were built.

Your attention is respectfully invited to the report of our chief engineer and the tables that follow in connection with this report.

NORTH METROPOLITAN SYSTEM.

The sections upon this system shown as incomplete in our last annual report have at this date (Oct. 1, 1895) been completed, with the exception of Section 35, Charlestown, Somerville and Medford, five hundred feet of which in the city of Somerville remains to be constructed. When this is completed the total length of sewer upon this system will be about forty-one miles, varying in size from a brick sewer nine feet in diameter at Deer Island, Winthrop and East Boston, to a vitrified pipe sewer twelve, fifteen or eighteen inches in diameter, at the opposite termini. This, with the eight and one-quarter miles in the Charles River valley, makes about fifty miles of metropolitan sewers constructed and in operation at this date.

The following settlements for land taken upon this system have been made during the year: —

The Boston & Albany Railroad Company, by its president, William Bliss, duly authorized by vote of his directors, by deed dated Oct. 4, 1894, releases and discharges the Commonwealth, its officers, agents and servants from all suits, actions, claims and demands for damages by reason of the taking made by this Board Aug. 17, 1891 (recorded Middlesex South District Registry, book 2064, page 142), for land in Everett. This deed is recorded in the said registry, book 2311, pages 545 and 548, and also embraces land on the Charles River system.

On Oct. 3, 1894, Gilbert A. A. Pevey, city solicitor of Cambridge, duly authorized thereto by the city council of said city, releases the Commonwealth, its officers, agents and servants for damages to property of said city caused by the taking dated Jan. 7, 1893 (recorded Middlesex South District Registry, book 2169, page 457).

On Nov. 13, 1894, Albert A. Pope, Grenville T. W. Braman and Henry D. Hyde, trustees of the Cambridge Field Company, quit-claimed to the Commonwealth "rights, privileges and easements" in two parcels of land in Cambridge included within the taking made by this Board dated Nov. 19, 1892 (recorded Middlesex South District Registry, book 2158, page 574). This deed is recorded in Middlesex South District Registry, book 2319, page 434, and is accompanied by a release from Grenville T. W. Braman, the assignee of two mortgages on said tracts, quit-claiming to the Commonwealth the "rights, privileges and easements" described in said deed. The said release is recorded in Middlesex South District Registry, book 2322, page 314.

John J. and Robert Henderson, by deed dated Dec. 13, 1894, quit-claimed to the Commonwealth "rights, privileges and easements" in land in Cambridge included within a taking made by this Board dated Dec. 7, 1893, and recorded in Middlesex South District Registry, book 2169, page 457. This deed is recorded in said registry, book 2337, page 521.

A deed given Dec. 27, 1894, by Lyman B. Jordan, releases the Commonwealth for damages to land in Malden taken by this Board July 23, 1892, and recorded in Middlesex South District Registry, book 2133, page 550. This deed is recorded in said registry, book 2337, page 522.

Bridget Reardon, on Dec. 18, 1894, released the Commonwealth for damages caused by the taking of this Board dated June 11, 1892, and recorded in Middlesex South District Registry, book 2124, page 126.

Silas H. Holland, by deed dated Dec. 10, 1894, quit-claimed to the Commonwealth "rights, privileges and easements" in land in Somerville embraced within the taking made by this Board Jan. 7, 1893, and recorded in Middlesex South District Registry, book 2169, page 457. Holland's deed is recorded in said registry, book 2338, page 281.

Alice C. Mann of Malden, by deed dated Jan. 31, 1895, quit-claims to the Commonwealth "rights, privileges and easements" in land in said Malden included within a taking made by this Board dated June 11, 1892, and recorded in Middlesex South District Registry, book 2124, page 123. Her deed is recorded in said registry, book 2341, page 110; and Edward Woodman, by deed dated Jan. 24, 1895, releases the Commonwealth, its officers, agents and servants from all suits, actions, claims and demands connected with or growing out of the construction of the metropolitan sewer across his premises lying between Akron and Sands streets, Cambridge, included within the taking made by this Board July 19, 1893, recorded in book 2210, page 481. The said deed of Woodman is recorded with Middlesex South District Deeds, book 2343, page 543.

A deed dated Jan. 19, 1895, from Charles A. Russell and others, quit-claims to the Commonwealth "rights, privileges and easements" in two parcels of land in Somerville included in the taking made by this Board Jan. 7, 1893, and recorded in Middlesex South District Registry, book 2169, page 457. This deed is recorded in said registry, book 2341, page 111.

Isaac H. Kendall of Winchester, by a quit-claim dated Feb. 28, 1895, releases to the Commonwealth "rights, privileges and easements" in land in said Winchester included within the taking made by this Board dated June 2, 1894, and recorded in Middlesex South District Registry, book 2282, page 388. This deed is accompanied by one from Andrew N. Shepherd of Milford, N. H., the mortgagee named in a certain mortgage from said Kendall, acknowledging full payment and satisfaction, and releasing to said Kendall all interest acquired under said mortgage. These two deeds are recorded in Middlesex South District Registry, book 2346, page 235.

A quit-claim deed from Wm. Vogler of Somerville, dated Feb. 13, 1895, releases to the Commonwealth "rights, privileges and easements" in land in said Somerville included within the taking made by this Board Jan. 7, 1893, recorded in Middlesex South District Registry, book 2169, page 457. This deed is recorded in said registry, book 2351, page 426.

Charles I. Travelli, Geo. A. Blaney and others, by deed dated Feb. 13, 1895, quit-claimed to the Commonwealth a parcel of land and "rights, privileges and easements" in another parcel in Somerville; said parcels being taken, the first by deed dated May 20, 1893 (recorded in Middlesex South District Registry, book 2197, page 139), the other by deed dated Jan. 7, 1893, and recorded in said registry, book 2169, page 457. This deed from Travelli and others is recorded in Middlesex South District Registry, book 2351, page 425, and is accompanied by a release from Alexis Torrey, Henry F. Woods and Selwyn Z. Bowman, trustees and assignees to the Commonwealth, releasing all the "right, title and interest" in the land so taken (recorded Middlesex South District Registry, book 2351, page 423).

Joseph E. Ober, by deed dated April 29, 1895, quit-claims to the Commonwealth "rights, privileges and easements" in land in Medford included within a taking made by this Board May 20, 1893, and recorded with Middlesex South District Deeds, book 2197, page 139. This deed from Ober is recorded in the aforesaid registry, book 2365, page 153, and is accompanied by a release from the Merchants Co-operative Bank, the mortgagee, quit-claiming to the Commonwealth the "rights, privileges and easements" described in the aforesaid deed from Ober to the Commonwealth. This release is recorded in Middlesex South District Deeds, book 2365, page 154.

By a release dated June 9, 1894, recorded Middlesex South District Deeds, book 2374, page 519, Augustus P. Clarke of Cambridge quit-claims to the Commonwealth the "rights, privileges and easements" in a piece of land in said Cambridge included within the taking of this Board made July 19, 1893, and recorded in the aforesaid registry, book 2210, page 481; and Albert W. Gould of Malden, by deed dated June 25, 1895, and recorded with the aforesaid deeds, book 2404, page 449, quit-claims to the Commonwealth "rights, privileges and easements" in a parcel of land in said Malden included within the taking of this Board dated July 23, 1892, and recorded with Middlesex South District Deeds, book 2133, page 550. The Malden Savings Bank, the mortgagee, gives a quit-claim to the Commonwealth of the "rights, privileges and easements" described in the aforesaid deed, which release is recorded in the aforesaid registry, book 2404, page 450.

On Aug. 10, 1895, settlement was made with the owners of land in East Boston taken in fee by this Board as the site of a pumping station, by deed dated Oct. 8, 1892 (recorded Suffolk Deeds, book 2088, page 541).

Three disinterested persons, having been mutually agreed upon as referees by all parties interested in the case, and having viewed the premises and heard the parties upon such evidence and proofs as they chose to present, with the arguments of counsel, did upon the aforesaid date report their findings to this Board, and upon the payment of the amount so found, together with certain costs and expenses, the owners of said estate did declare themselves satisfied in the cases pending in court.

Damages sustained to land in Woburn belonging to David T. and Abby R. Strange, included within the taking made April 15, 1893, and recorded with Middlesex South District Deeds, book 2186, page 585, were paid by the Commonwealth upon an execution issued from the superior court; similar damages, sustained by A. V. Lynde and Ellen Gateley to their lands on Spot Pond Brook, Malden, included within the taking made July 23, 1892, and recorded with the aforesaid deeds, book 2133, folio 550, were paid upon a similar execution; and the claims of Orlando W. Norcross, by reason of damage sustained by him to land in Everett included within the taking made Aug. 17, 1891, recorded in the aforesaid registry, book 2064, page 142, were satisfied upon an execution issued as aforesaid.

Land Takings.

The land takings of the year have been but few, and are either to cover those portions mentioned in the extract from our report for the year ending Sept. 30, 1894 (already quoted), as necessary for the pumping station and three spurs on the Alewife Brook line, or are intended to supplement and enlarge takings formerly made.

On April 27, 1895, this Board executed a deed (recorded Middlesex South District Deeds, book 2361, page 45) taking, partly in fee and partly in easement, certain tracts in Medford, Somerville and Arlington, for the site of the Alewife Brook pumping station, the sand-catcher and siphon at Mystic River in that neighborhood, and the 1,700 feet of spurs previously mentioned.

On July 13, 1895, a deed was executed taking in fee simple area at the site of the pumping station at Charlestown in addition to that taken by the deed of June 24, 1893 (recorded Suffolk Deeds, book 2142, page 311). The deed for the additional taking was recorded with Suffolk Deeds, book 2294, page 225; and, finding that part of the area covered by these two deeds lay within Middlesex County in the city of Everett, a taking was executed on the twenty-fourth day of August, 1895 (recorded Middlesex South District Deeds, book 2391, page 1), taking in fee simple that portion of the aforesaid tract lying within Middlesex County.

On Aug. 10, 1895, this Board took an easement in additional area in Belle Isle Inlet, Winthrop, adjacent to that taken by deed dated May 7, 1890, and recorded with Suffolk Deeds, book 1934, page 487. This deed is recorded with Suffolk Deeds, book 2299, page 488.

On Sept. 14, 1895, this Board by deed (recorded Middlesex South District Deeds, book 2401, page 161) took an easement in certain land in Somerville and Arlington adjacent to the taking made by this Board Jan. 7, 1893, recorded with Middlesex South District Deeds, book 2169, page 457. This taking is recorded with the aforesaid deeds, book 2401, page 161, and was taken at the request of Arlington to enable said town to connect her local sewers at this point with the metropolitan sewer, the said town agreeing to pay any and all damages resulting from such taking.

Location of Sewer Line.

As stated in the preceding paragraph, the land takings have been few the past year. The spurs in the neighborhood of the Alewife Brook pumping station, all of them embraced within takings through private land, practically cover the whole of the lines not under contract at the time of making our last annual report, and complete the sewers on the north metropolitan system.

The additional takings that have been made in connection with the pumping stations have necessitated applications for the approval of the Harbor and Land Commissioners as follows: On July 27 application was made for an enlargement of the structures authorized by the License 1599, issued Sept. 29, 1892, by said commission; and said license was granted Aug. 13, 1895, and has been recorded with Suffolk Deeds, book 2316, page 135. The change thus authorized is at the site of the pumping station at East Boston.

On September 18 a similar license was granted, approving the additional taking at the site of the Charlestown pumping station, and such license has been recorded in the Suffolk Registry of Deeds, book 2316, page 134, and also in the Middlesex South District Registry, book 2415, page 327.

Contracts.

Table A in the Appendix contains a full list of all bids received and contracts awarded during the past year. These bids were solicited either by publicly advertising the same or by soliciting bids by direct communication with well-known parties, and in all cases the bids were opened and read publicly in the presence of the Board and such spectators as chose to attend. A glance at the table will show that the bids thus received relate entirely to the pumping stations and the siphon crossing Belle Isle Inlet; and of these the pumping station at Alewife Brook, the coal pocket at Charlestown, the coal shed and screen house at East Boston, the overflow at Belle Isle Inlet and the coal shed and family house at Deer Island were all duly advertised in one or more of the daily papers.

In the case of the overflow at Belle Isle Inlet all the bids were rejected, the Board determining to construct the same under the direction of the chief engineer by day labor; and the award in all other cases was to the lowest bidder who duly furnished bonds and executed the contract.

The 1,700 feet of sewer in the neighborhood of the Alewife Brook pumping station previously referred to were constructed by day labor under the direction of the engineer.

On Nov. 3, 1894, the following certificate was presented to the Board by the chief engineer: —

BOSTON, Nov. 3, 1894.

HOSEA KINGMAN, TILLY HAYNES, HARVEY N. COLLISON,
Metropolitan Sewerage Commissioners.

GENTLEMEN: — As I have heretofore stated to you in person, the work remaining to be done on Section 37 is in my opinion unnecessarily and unreasonably delayed.

Yours respectfully,
(Signed) H. A. CARSON,
Chief Engineer.

The Board thereupon

Voted, That John Sheehan, the contractor for work on Section 37, be notified to discontinue all work under his contract for work on said section; that work on said section be immediately prosecuted by the Board, under the direction of the engineer, in accordance with the provisions of Section L of his contract.

The contractor and his bondsmen were duly notified thereof, and at a later meeting the contractor with his counsel appeared asking that the Board reconsider its action. This the Board after due consideration declined to do, and has since completed said section under the direction of its engineer at an expense over the contract price of $141.83. The contractor and his bondsmen have been duly notified thereof.

In our previous reports four similar cases have been mentioned where the work has been taken from the contractor, in accordance with the provisions of the contract, to be completed by the Board.

The first of these, reported in our fifth annual report (Public Document No. 45, 1894), was in the case of McGovern & Kitch, contractors on Section 27, who were notified on Oct. 15, 1892, in accordance with their contract, to discontinue all work on said section. On March 1, 1894, they were notified that said section had been completed at a cost of $17,489.20 in excess of the contract price, and payment to the Commonwealth of the amount of the bond demanded. This case is on the trial list in the superior court of the Commonwealth, and is likely to be reached in the near future, action having been brought by the Commonwealth against the contractors and their surety, the American Surety Company of New York.

The second case was that of Thomas J. Young & Co., reported in the sixth annual report (Public Document No. 45, 1895). The said parties were contractors for a sand-catcher, siphon and sewer across Abbajona River, Winchester, their bid for the same being $2,297. They were notified on May 19, 1894, to discontinue all work, and under the direction of the chief engineer the work was taken and duly completed, at an advance over their bid of $1,528.95.

On July 21, 1894, upon certificate of the chief engineer that the work on Section 7, Belle Isle Inlet, was unnecessarily and unreasonably delayed, the Board notified the contractors (Trumbull & Ryan) and their bondsmen that work on said section would be prosecuted by this Board under the direction of its engineer; and since then the said section has been completed by the Commonwealth, at an expense exceeding the amount of the bond $606.34. Negotiations are now pending between this Board and the contractors in relation to a settlement.

The chief engineer on Sept. 12, 1894, notified the Board that work on Section 39 (Metropolitan Construction Company, contractors), especially on Porter Street, between Bremen Street and Central Square, East Boston, was unnecessarily and unreasonably delayed, and at the same time the Board passed a vote taking from said company that portion of the section. This portion has since been completed by the Board, at an expense in excess of contract prices of $9,352.01, of which amount the Commonwealth is entitled to collect under the contract $7,664.53. The surety on the bond (American Surety Company of New York) was duly notified of the Board's action in taking the work from the contractor; but, there being sufficient funds in the hands of the Commonwealth belonging to said contractor to more than reimburse it for the amount due, notice of the amount of excess of cost of construction has been served upon the contractor only. The last two cases were mentioned in the sixth annual report.

CLAIMS OF CONTRACTORS.

But one case of this kind has arisen the past year. In January last Lindsay & Cudmore, the contractors upon Section 47, asked for additional compensation for losses sustained on account of extra labor in handling quicksand, etc., upon said section; but the Board, after hearing them and duly investigating and considering said claim, rejected the same.

MYSTIC VALLEY SEWER.

In the fifth annual report of this Board (Public Document No. 45, 1894) the taking of this sewer is reported as follows: —

> The Mystic valley sewer and land necessary for a parallel line, together with the purifying works near the Mystic station on the Boston & Lowell Railroad, were taken by two deeds, executed July 14, 1893, and recorded in Middlesex South District Deeds, book 2210, page 161, and book 2210, page 162; the former taking the land and buildings in Winchester owned by the city of Boston and used as the purifying station of the Mystic valley sewer, and the latter such portions of the Mystic valley sewer itself as were necessary for the completion of this system, together with land sufficient for a parallel line. The city of Boston, who owned this sewer, authorized its transfer to the Commonwealth by the following vote: —

IN BOSTON WATER BOARD, BOSTON, Aug. 23, 1893.

Voted, To release to the Commonwealth of Massachusetts, for the sum of fifty-two thousand six hundred and thirty-seven dollars ($52,637), all the right, title and interest which the city of Boston now has vested in it by virtue of a certain taking, recorded with Middlesex South District Deeds. Aug. 9, 1877, book of partitions, etc., 27, page 491, and by a certain taking recorded with said deeds. Dec. 13, 1881, book 1586, page 241, or otherwise has in and to any of the land described in either of two certain takings made by the Metropolitan Sewerage Commissioners in behalf of said Commonwealth, both dated July 14, 1893, and recorded with said deeds, July 18, 1893, or to the buildings or machinery on the premises described therein.

Also, for said consideration, to release and discharge the said Commonwealth, its officers, agents and servants, from all claims, demands, actions and causes of action by it for damages, costs, expenses or compensation by reason of the said two takings by said Metropolitan Sewerage Commissioners, or any lawful acts done under the authority thereof in pursuance of the said takings.

Also, for said consideration, to covenant and agree with the said Commonwealth that it will maintain the sewer and works in the premises above referred to, and provide for the disposal of all sewage entering therein as heretofore, until such time as the said commissioners shall have so far constructed and completed the sewerage system provided for by the plans referred to in chapter 439 of the Acts of 1889, or within the purpose of said act, as to be able to dispose of sewage at the outlet off Deer Island, provided the same shall be constructed on or before July 18, 1895, or otherwise until said day, but no longer; and after said July 18 the Commonwealth shall provide for the disposal of such sewage.

And that the chairman of this Board be authorized to countersign an instrument covering the matter above set forth; and, as the matter does not admit of delay, that the acting mayor be requested to forthwith execute, acknowledge and deliver such instrument.

A true copy. Attest:

(Signed) W. E. Swan,
Secretary.

On Oct. 3, 1893, the mayor of said city and the chairman of the Boston water board, by deed recorded in Middlesex South District Deeds, book 2242, page 5, conveyed to the Commonwealth the sewer and works named herein in accordance with said vote.

The provisions of the above vote of the Boston water board, regarding the disposal of sewage from said sewer after July 18, were inserted in and formed a part of the above-mentioned deed. This Board therefore was obliged to assume the disposal of sewage from the said Mystic valley sewer on or before midnight of said day; and measures to this end had been in progress for some six months or more.

On Dec. 1, 1894, W. F. Learned, superintendent of the purifying works of the city of Boston on said sewer, met the Board by request and gave them information regarding the methods and cost of such process; and upon the 22d of the same month the Board appointed a hearing for Saturday, December 29, to the selectmen of Stoneham and the sewer commissioners of Woburn and Winchester, with the several tanners using the said Mystic valley sewer, in accordance with the following notices: —

COMMONWEALTH OF MASSACHUSETTS,
METROPOLITAN SEWERAGE COMMISSION, 110 BOYLSTON STREET,
BOSTON, Dec. 22, 1894.

To the Board of Sewer Commissioners of the City of Woburn, Woburn, Mass.

GENTLEMEN: — The Board of Metropolitan Sewerage Commissioners hereby notifies you that the system for the Mystic valley, known as the north metropolitan system, in which your city is included, is nearing completion, and it is expected will be put in operation at no distant day. When such operation begins, it will be necessary for this Board to exclude from said system all tan bark, hair, fat of animals or other substances that would tend to obstruct or impede the flow of sewage in the sewer. The Mystic valley sewer, formerly owned and operated by the city of Boston, has been taken and purchased by this Board for the Commonwealth as a part of the north metropolitan system, and said city will cease operating the same when the metropolitan system shall be put in operation.

This Board will be glad to consult with you Saturday, Dec. 29, 1894, at 10 o'clock A.M., at this office, in relation thereto.

For the Board,
(Signed) EDWARD P. FISK,
Clerk.

A copy of the above, enclosed in a note similar to the following —

COMMONWEALTH OF MASSACHUSETTS,
METROPOLITAN SEWERAGE COMMISSION, 110 BOYLSTON STREET,
BOSTON, Dec. 26, 1894.

Messrs. JAMES SKINNER & CO., *Green Street, Woburn, Mass.*

GENTLEMEN: — I enclose a copy of notice sent to the sewer commissioners of your city. This Board will be pleased to have you attend said hearing on Saturday next, at 10 o'clock A.M., at this office.

For the Board,
(Signed) EDWARD P. FISK,
Clerk.

was sent to the tanners using the sewer, and at the hearing thus appointed there were present the sewer boards of Woburn and Winchester, with the selectmen of Stoneham and representatives of most of the tanneries using the sewer, together with W. F. Learned, the superintendent of the purifying works of the city of Boston. The meeting was held to consider the best course for the Commonwealth to pursue in relation to the sewage from the tanneries, disposed of at the purifying station at Winchester, when the north metropolitan system, of which this sewer was designed to form a part, should be put in operation. Some two hours were spent in discussion of the matter, all parties agreeing to further consider the subject as opportunity offered. At this meeting the tanners and others present had their attention directed especially to the sentence in the Board's communication to the sewer commissioners and the selectmen, as follows: "When such operation begins, it will be necessary for this Board to exclude from said system all tan bark, hair, fat of animals or other substances that would tend to obstruct or impede the flow of sewage in the sewer."

The town of Stoneham, having but a small representation at this hearing, requested further time; and the Board appointed a special hearing for them on Saturday, Jan. 5, 1895, when a larger number attended and discussed the subject, the Board finally advising that they be represented at a meeting of parties interested to be held in Woburn in the near future, that concerted action might be taken.

No further action was taken by the Board until the middle of March, although in the mean time available information and data were being collected. On the 16th of that month the engineer was authorized to consult with W. F. Learned, the superintendent, and also to visit the different tanneries, and report some plan for operating the sewer when said works were taken in charge by the Commonwealth. He made a report to the Board on April 20, which report was resubmitted to him for revision; and upon May 4 he submitted to the Board the following report: —

April 23, 1895.

Hosea Kingman, Tilly Haynes, Albert F. Noyes,
Metropolitan Sewerage Commissioners.

Gentlemen: — On Saturday, April 20, you requested me to consider: —

First. — What construction, if any, is needed in connection with that portion of the Mystic valley sewer acquired by your Board from the city of Boston, that it may safely be operated as a branch of the metropolitan system?

Second. — What changes are required in the character of the manufacturing wastes now flowing in the Mystic valley sewer, that the resulting sewage may be safely handled in the metropolitan sewers?

In response to this request I submit the following report: —

The Mystic valley sewer was constructed in 1878 by the water board of the city of Boston, to divert tannery drainage in Winchester and Woburn from the Mystic water supply. It consists of 2.24 miles of 26 by 28 inch brick, and 1.33 miles of 15 and 10 inch pipe sewer, and extends from its outlet, near the head of the Lower Mystic Lake, in Medford, to Prospect Street, in Woburn. As originally built, 6 inch pipe branches were extended to nine tanneries, two in Winchester and seven in Woburn, with large masonry catch-basins at the ends of these pipe branches in the tannery yards. The Boston water board constructed the sewer, the pipe branches and the masonry catch-basins. Since 1889 a chemical precipitation plant has been operated near the outfall on land at Bacon's crossing in Winchester.

The city engineer of Boston reports that in 1894 the average daily delivery of the sewer was about 361,000 gallons. This amount may be approximately subdivided as follows: —

Manufacturing Wastes from the Tanneries.

NAME.	Location.	Daily Delivery of Manufacturing Wastes into the Mystic Valley Sewer (Gallons).
Alex. Moseley, now Beggs & Cobb,	Swanton Street, Winchester, near Woburn line, . . .	70,000
Shaw & Taylor, ...	Woburn, near Winchester line,	20,000*
J. P. Crane, ...	Woburn, near Winchester line,	10,000
Bryant & King, now F. A. Loring, .	Near Conn Street, Woburn, .	20,000
Middlesex Leather Company, . .	Near Conn Street, Woburn, .	18,000
Eustis Cummings, ...	Near Fowle Street, Woburn, .	15,000
White, Osborn & Co., now W. P. Fox,	Near Fowle Street, Woburn, .	7,500
J. Houston & Co., ...	Near Green Street, Woburn, .	5,000†
James Skinner & Co., ...	Near Green Street, Woburn, .	20,000
E. M. Blake, now E. C. Cottle, . .	Near Fowle Street, Woburn, .	20,000
Total gallons of manufacturing wastes per day from the tanneries,		205,500

* Shut down since June 1, 1894.

† Shut down since Jan. 1, 1895.

The remaining 150,000 gallons per day consist of ground water leakage, dry weather flow of Russell's Brook, in Woburn, containing laundry drainage, and drainage from houses in Winchester and

Woburn. This 150,000 gallons per day is ordinary sewage, which can be safely handled in the metropolitan sewers, and needs no further consideration.

On Oct. 3, 1893, your Board acquired so much of the Mystic valley sewer as extends from the outlet to a point 80 feet north of the Woburn city line, a length of 2.79 miles, including land rights, precipitation works and all other improvements and appurtenances except the branches to the tanneries. This length includes all the brick sewer and 2,890 feet of the 15 inch pipe. On this length there is at present but one pipe branch, to Moseley's tannery, near the Woburn line. When operated by your Board this length of Mystic valley sewer becomes like any other section of the metropolitan system. To insure that only sewage of a suitable character be delivered to it, shut-off valves or plugs should be provided at the 6 inch pipe connection from Moseley's tannery, and at the end of your section on the 15 inch pipe near the Woburn line.

The 200,000 gallons per day of tannery wastes contain about 16 cubic yards of sludge, fine tan bark, etc. Of this, 10 cubic yards per day of the coarsest is now intercepted at the catch-basins, and the remaining 6 cubic yards of the finest thrown down at the precipitation works. When the precipitation works are abandoned, the 6 cubic yards per day of fine tan bark now removed will flow off into the metropolitan sewer, if permitted, as matter in suspension, and in time will collect on the bottom and sides of the sewer, seriously affecting the flow. The fine tan bark, which constitutes the great bulk of the solids in the tannery wastes, is found in the liquor from the tan presses. In some other parts of the State large tanners find this of sufficient value to strain and deliver again to the vats. A good example of this practice is found at the works of the Robson Leather Company, at Salem, Mass. This is a tannery handling nine hundred hides per day. The liquor from the tan presses is strained in two not expensive tanks, costing say one hundred dollars for both, and finally pumped to the vats again, so that in the manufacturing wastes from this large establishment there is no tan bark. The Robson Leather Company find this practice to be profitable. It would be no hardship for the tanners of Winchester and Woburn to carry out this same process; doubtless it would yield them a profit. The remainder of the tannery wastes is found in drainage from the beam house, containing lime, hair, grease and fragments of hide. Under efficient maintenance, in tanks of ample capacity, having screens for intercepting the hair, fat and fragments of hide, this drainage could be handled in the metropolitan sewers. To this end improved tanks should be built at the tanneries or elsewhere.

The suggestions offered in the matter are as follows: —

First. — Shut-off valves or plugs must be provided at the end of your 15 inch pipe sewer near the Woburn line and on the 6 inch pipe branch to Moseley's tannery.

Second. — Applications for connections with this branch of your system should be entertained only from cities and towns; such has been your practice on other branches of the metropolitan system.

Third. — Require that liquor from the tan presses be excluded from the sewage delivered to the metropolitan branches.

Fourth. — Drainage from the beam house to be passed through improved settling tanks, with screens, which will intercept the hair, grease and fragments of hide.

These suggestions are substantially in accordance with the policy of the Board, and the requirements are similar to those provided and now maintained in connection with the abattoir sewer connection with the Charles River system at Brighton.

As the studies and constructions needed to produce the changes outlined will occupy some weeks, notice should be sent to the proper officials of the cities of Boston and Woburn and the town of Winchester, stating that, at an early date, that portion of the Mystic valley sewer which you have acquired will be operated as a branch of the metropolitan system, and that you are prepared to receive applications for permission to deliver into it sewage that can be safely handled in the metropolitan mains.

Respectfully submitted,

(Signed) WM. M. BROWN, JR.,
Acting Chief Engineer.

A copy of this report was sent to the sewer commissioners of Woburn and Winchester and the selectmen of the town of Stoneham, with the following communication: —

COMMONWEALTH OF MASSACHUSETTS,
METROPOLITAN SEWERAGE COMMISSION, 110 BOYLSTON STREET,
BOSTON, May 7, 1895.

To the Board of Sewer Commissioners of the City of Woburn, Woburn, Mass.

GENTLEMEN: — In the near future that portion of the Mystic valley sewer taken by the Commonwealth will be operated as a part of the metropolitan system. The Board is now prepared to receive applications for connection with said portion of said sewer and for permission to deliver sewage therein. When the Commonwealth does commence to operate this part of the metropolitan system, such substances in such proportion as the same are now permitted to flow into and through said portion of said sewer from the tanneries can be no longer received, and must be cut off. Some provision, either at the points of connection with the metropolitan system or elsewhere, must be made to keep out of this system, as far as possible, the objectionable matter (tan bark, hair and fat) now permitted to flow from the tanneries into the Mystic valley sewer.

Enclosed please find report of engineer of this Board, for further information.

For the Board,
(Signed) Edward P. Fisk,
Clerk.

A copy of the same report was at this time mailed to the water board of the city of Boston with the above communication, with the addition of a paragraph inserted after the paragraph ending "the objectionable matter (tan bark, hair and fat) now permitted to flow from the tanneries into the Mystic valley sewer," as follows: "The city of Boston will require a connection with the metropolitan system for its sewers at two points, one at the end of the taking made by this Board of the Mystic valley sewer, eighty feet north of the Woburn line, and one at the point of intersection of its sewer from the Moseley tannery with the Mystic valley sewer." In answer to the above the sewer commissioners of the city of Woburn met the Board on May 31, to inquire regarding that portion of the old Mystic valley sewer lying within said city and not included within the taking made by this Board on July 14, 1893. As the city of Boston owned said portion of said sewer, they were referred to the Boston water board in relation thereto.

On June 22 the following communication was sent by direction of the Board to the sewer commissioners of Woburn and the Boston water board: —

Commonwealth of Massachusetts,
Metropolitan Sewerage Commissioners, 110 Boylston Street,
Boston, June 22, 1895.

To the Board of Sewer Commissioners of the City of Woburn, Woburn, Mass.

Gentlemen: — Your attention is called to the notice from this Board, dated May 7, 1895. There is within the limits of the city of Woburn a part of the old Mystic valley sewer, which by the taking made by this Board has become a local sewer. If it is intended by the city of Woburn to operate this local sewer and to receive sewage therein, it is quite important that it should be connected with the metropolitan sewer. Such connection should be made with the approval of this Board, and so made that at the point of connection the amount and kind of sewage received can be so examined, regulated and controlled that the metropolitan system may be fully protected against probable injury and obstruction. As this Board desires in the near future to clean out and operate that part of the old Mystic valley sewer taken by the Commonwealth, application should be made at once to this Board for a connection of said local sewer with the metropolitan sewer.

For the Board,
(Signed) Edward P. Fisk,
Clerk.

To this the following reply was received: —

City of Woburn, Office of Sewerage Commissioners,
Woburn, Mass., July 3, 1895.

To the Board of Metropolitan Sewerage Commissioners, Boston, Mass.

Gentlemen: — Your letter to us, dated June 22, suggesting that a connection should be made of the local part of the old Mystic valley sewer lying in Woburn with the metropolitan sewer, was duly received and should have been answered earlier.

You are doubtless aware that the Mystic valley sewer, not included in the Commonwealth's taking, is the property of the city of Boston, and is controlled by it. This Board therefore has no authority to make an application for a connection of that sewer with your system.

Upon the receipt of your letter we took measures to learn what the position of the city of Boston would be respecting this local sewer, and we have been informed, unofficially, that the city of Boston would not part with its property in or give up its control of that sewer. That we might have explicit and official information in the matter, we have written to the Boston water board, asking whether the sewer could be purchased by the city of Woburn; and upon receiving a reply from that board we should be pleased to correspond with you further on the subject.

For the Board,
(Signed) G. W. Buchanan,
Clerk.

The following letter from the water commissioner of the city of Boston was also received: —

Office of the Water Commissioner, City Hall,
Boston, July 10, 1895.

To the Metropolitan Sewerage Commissioners.

Gentlemen: — Under the terms of our agreement, dated Oct. 3, 1893, the Commonwealth is to assume and provide for the disposal of the sewage entering the sewer and works in the city of Winchester on the nineteenth day of July, 1895. I desire to call your attention to this fact, in order that you may have ample time to prepare for assuming the charge of the work which the city is now doing for the Commonwealth under this agreement.

Very truly yours,
(Signed) Chas. W. Smith,
Water Commissioner.

Boston's water commissioner met this Board by appointment on July 13, and agreed to appoint a representative to meet one from this Board at the works in Winchester for consultation in relation to putting the Mystic valley sewer in order for transfer to the Commonwealth. The following letter was sent to the sewer commissioners of Woburn by the Board's direction: —

Commonwealth of Massachusetts,
Metropolitan Sewerage Commissioners, 110 Boylston Street,
Boston, July 13, 1895.

To the Sewer Commissioners of the City of Woburn, Woburn, Mass.

Gentlemen: — We understand that negotiations are pending between your city and the city of Boston for that portion of the Mystic valley sewer not taken by the Commonwealth lying within the limits of Woburn.

As the time is approaching when the Mystic valley sewer passes into the care and custody of the Commonwealth, it is necessary that you make an immediate application to this Board for a connection of that portion of the sewer above referred to with the metropolitan sewer, as otherwise it will be necessary to cut off the said portion of sewer at its junction with the State sewer.

This Board meets on Thursday next, the 18th inst., at 10 o'clock A.M., when application can be made for such connection.

For the Board,
(Signed) EDWARD P. FISK,
Clerk.

The sewer board of Woburn met this Board as appointed, and, after obtaining permission from the water commissioner of Boston to use that portion of the Mystic valley sewer within the limits of the city of Woburn temporarily, filed a petition with this Board for a connection of said sewer with the State sewer at the point of junction of the two. A permit for said connection was approved by this Board, upon condition that such connection be temporary, and that no spent tan bark should be allowed to enter the sewer, and also that sewage from the beam house should be properly screened.

On the same evening the keys of the purifying works in Winchester were delivered to a representative of this Board, and the works there located were closed and abandoned, the sewage formerly treated there being allowed to flow directly into the metropolitan sewer.

A plan for settling tanks at the various tanneries was submitted to the Board and by them approved at a later meeting, and close watch was kept of the sewage discharged from such tanneries, so that early in August the clerk was directed to call attention of the sewer commissioners of Woburn to the condition of the tannery sewage discharged by that city at its connection with the Mystic valley sewer temporarily authorized by this Board on July 18, which was done by the following communication: —

COMMONWEALTH OF MASSACHUSETTS,
METROPOLITAN SEWERAGE COMMISSIONERS, 110 BOYLSTON STREET,
BOSTON, Aug. 14, 1895.

To the Board of Sewer Commissioners of the City of Woburn, Woburn, Mass.

GENTLEMEN: — On July 18 this Board granted you the right to connect, *temporarily*, so much of the Mystic valley sewer lying within the limits of your city as was not purchased by the Commonwealth with the metropolitan sewer in that locality; but only upon the expressed condition that tannery sewage, and especially that from the beam house, should be screened before entering the metropolitan sewer, so as to exclude substances likely to retard operations in said sewer. This has not been thoroughly done, as hair and other substances are discharged in quantities sufficient to necessitate the attention of men at this point.

Your immediate attention is called to this fact, as a continuance thereof would necessitate the revoking of the permit then granted.

For the Board,
(Signed) Edward P. Fisk,
Clerk.

In answer to the above a representative of the Woburn board met this Board at its meeting on August 24, regarding the same, and your attention is respectfully called to the engineer's report submitted herewith for further information regarding the operation of said sewer.

Connections with the Metropolitan Sewer.

As previously stated in this report, the authorities of certain of the cities and towns in this system were notified of the completion and opening of the sewer by a communication, as follows: —

Commonwealth of Massachusetts,
Metropolitan Sewerage Commissioners, 110 Boylston Street,
Boston, May 27, 1895.

To the Board of Sewerage Commissioners of Winthrop.

Gentlemen: — You are hereby notified that on and after June 1, 1895, the metropolitan sewer within the limits of the town of Winthrop will be in operation, and you will be permitted to discharge into it sewage of a character satisfactory to the Board through any properly authorized connection.

The bulkheads of the metropolitan sewer will, upon request from you, be removed from your connections when overflows and regulators are satisfactory to the engineer of the Board.

For the Board,
(Signed) Edward P. Fisk,
Clerk.

A similar notice was sent to the proper authorities of the towns of Arlington, Belmont and Melrose, and also of the cities of Chelsea, Medford, Malden and Everett. The cities of Cambridge and Somerville were likewise notified that that portion of the metropolitan sewer within their limits known as the "Alewife Brook line" would be ready for use at the same time; and early in September the city of Boston, together with the said cities of Cambridge and Somerville, were notified that on and after the 23d of the same month (September) they would be permitted to discharge sewage into the metropolitan sewer at any authorized connection within their limits. The city of Woburn and the town of Winchester were notified of the opening of the sewer, and all these localities have availed themselves of the opportunity thus offered to dispose of sewage. The following table shows the connections made with the north metropolitan system for the year ending Sept. 30, 1895: —

Connections with North Metropolitan Sewer, authorized to Oct. 1, 1895.

DATE AUTHORIZED.	City or Town.	Location of Connection.	Size.	Date of Completion.
May 26, 1894,	Medford, .	North side of Metropolitan sewer, in Riverside Avenue, junction of Spring Street, .	15 inch,	Oct. 19, 1894.
May 26, 1894,	Medford, .	South side of Metropolitan sewer, Riverside Avenue, junction of Park and Marine Avenue, ...	12 inch,	Nov. 9, 1894.
Aug. 25, 1894,	Medford, .	In private land, south of High Street, about 460 feet west of Winthrop Street, . . .	12 inch,	Nov. 20, 1894.
Oct. 4, 1895,*	Cambridge,	Portland Street at Binney Street, by a circular sewer, .	4 foot,	Dec. 4, 1894.
July 21, 1894,	Melrose, .	Corner Wyoming Avenue and Pleasant Street, . . .	20 inch,	Dec. 15, 1894.
Aug. 25, 1894,	Malden, .	Mountain Avenue, . . .	15 inch,	Dec. 17, 1894.
Jan. 27, 1894,	Winthrop, .	Shirley Street, corner Washington Avenue, Winthrop Beach Station, ...	12 inch,	Jan. 17, 1895.
June 22, 1895,	Winchester,	Main, corner Church Street, No. 1, ...	10 inch,	Feb. 27, 1895.
June 22, 1895,	Winchester,	Common Street, No. 2, . .	10 inch,	Feb. 27, 1895.

* Cambridge was allowed to make this connection in December, 1894, but said connection was bulkheaded off and permission was given to use the same Oct. 4, 1895, the line having been put in operation Sept. 23, 1895.

Connections with North Metropolitan Sewer, etc. — Concluded.

Date Authorized.	City or Town.	Location of Connection.	Size.	Date of Completion.
June 22, 1895,	Winchester,	Rear of freight sheds, Boston & Maine Railroad, No. 3, . .	15 inch,	Mar. 21, 1895.
Nov. 3, 1894,	Malden, .	Medford Street, corner Canal Street, ...	15 inch,	Mar. 30, 1895.
March 2, 1895,	Belmont, .	Near Hill's Crossing, . . .	15 inch,	June 13, 1895.
May 4, 1895,	Cambridge,	Massachusetts Avenue and Alewife Brook, ...	15 inch,	June 14, 1895.
May 4, 1895,	Cambridge,	Belmouth Rindge Avenue, formerly Spruce Street, . .	15 inch,	June 26, 1895.
April 20, 1895,	Everett, .	West Everett, near Faxon's Foundry, ...	20 inch,	July 10, 1895.
July 6, 1895,	Medford, .	Middlesex Avenue and Third Street, Wellington district, .	15 inch,	July 16, 1895.
– –	–	Turned the old Mystic valley sewer into the metropolitan sewer, ...	–	July 18, 1895.
Jan. 26, 1895,	Winchester,	Near siphon at Mystic station, Abbajona River, No. 5, . .	10 inch,	July 24, 1895.
Jan. 26, 1895,	Winchester,	Old Mystic Valley sewer, near Abbajona River, No. 4, . .	10 inch,	Aug. 8, 1895.
May 4, 1895,	Cambridge,	Concord Avenue, ...	15 inch,	Aug. 21, 1895.
July 6, 1895,	Winthrop, .	Pleasant Street, near Belle Isle Inlet, ...	12 inch,	Aug. 24, 1895
July 6, 1895,	Cambridge,	Mt. Auburn Street and Lowell Street, ...	27 by 28 inches,	Aug. 24, 1895.
July 6, 1895,	Woburn, .	Old Mystic valley sewer at Cross Street, ...	15 inch,	Sept. 2, 1895.
July 6, 1895,	Medford, .	Craddock Avenue, Wellington district, ...	12 inch,	Sept. 18, 1895.
Aug. 24, 1895,	Arlington, .	Henderson Street, at Alewife Brook, ...	10 inch,	Sept. 20, 1895.

In our last annual report (page 30) thirteen connections with this system were shown as having been authorized by this Board; seven of these were made prior to Oct. 1, 1894, distributed as follows: Malden, two; Everett, one; and Medford, four, making seven connections actually made to Oct. 1, 1894. During the year ending Sept. 30, 1895, twenty-four connections with the north metropolitan sewer have been made, as follows: Cambridge, Medford and Winchester, five each; Malden and Winthrop, two each; Everett, Woburn, Melrose, Arlington and Belmont, one each; total, twenty-four. This makes thirty-one connections made with this system to Oct. 1, 1895, which are distributed as follows: Cambridge, five; Everett, two; Malden, four;

Medford, nine; Woburn, one; Arlington, one; Belmont, one; Melrose, one; Winchester, five; Winthrop, two; total, thirty-one. This Board has authorized at this date six connections which have not been made as yet, distributed as follows: Boston (East Boston), one; Medford, two; Cambridge, two; and Woburn, one.

Expenditures.

The expenditures upon this system, including all payments on account of contracts during the twelve months ending Sept. 30, 1895, amount to $606,488.61. This, with the amount previously reported, $3,949,716.31, makes the total expenditures to date $4,556,204.92. Table C in the Appendix contains a full statement of the cost of operation for the year ending Sept. 30, 1895. Your attention is called to the tables submitted herewith for matters of detail.

CHARLES RIVER VALLEY SYSTEM.

This system has been steadily in operation during the past year, and a full statement of the expenses thereof, for the year ending Sept. 30, 1895, will be found in Table D in the Appendix. This shows an unexpended balance of $14,296.35 at that date, which we estimate will be sufficient to meet operating expenses on this system until Jan. 1, 1896, or until such time as a new appropriation shall be made therefor. It is of interest to note that with the year 1895 four years of operating this sewer will practically have closed, and that the contract made with the city of Boston on the sixteenth day of April, 1892, for receiving sewage from this section into its sewers at the corner of Huntington Avenue and Gainsborough Street in said city, and disposing of it at the outlet of its system at Moon Island, also expires.

On Sept. 27, 1890, this Board had, in conjunction with its petition to the supreme judicial court, made in pursuance of the provisions of section 13, chapter 439, Acts of 1889, certified to the treasurer of the Commonwealth its estimate of the cost of maintaining and operating the system, as follows : —

To the Treasurer of the Commonwealth of Massachusetts

The Board of Metropolitan Sewerage Commissioners, in pursuance of the requirements of section 13 of chapter 439, do hereby certify that they estimate the cost of the maintenance and operation of the system of sewage disposal for the cities of Boston, Waltham and Newton, and the towns of Watertown and Brookline (called by us the Charles River valley system), as follows : —

Item 1.	For the years 1890 and 1891, ...	Nothing.
Item 2.	For the year 1892, taking sewage from all the cities and towns included in said system, . .	$26,500 00
Item 3.	For the year 1893, taking sewage from same cities and towns, ...	26,500 00
Item 4.	For the year 1894, taking sewage from same cities and towns, ...	27,000 00
Item 5.	For the year 1895, taking sewage from same cities and towns, ...	28,000 00

In making this estimate, we assume that we shall meet with no more serious obstacles in construction than the work thus far accomplished has developed.

HOSEA KINGMAN,
TILLY HAYNES,
R. T. DAVIS,
Metropolitan Sewerage Commissioners.
By EDWARD P. FISK,
Clerk.

BOSTON, Sept. 27, 1890.

Early in the year the following communication was sent to His Honor the mayor of the city of Boston : —

COMMONWEALTH OF MASSACHUSETTS,
METROPOLITAN SEWERAGE COMMISSIONERS, 110 BOYLSTON STREET,
BOSTON, Jan. 19, 1895.

HON. EDWIN U. CURTIS,
Mayor of the City of Boston, City Hall, Boston, Mass.

DEAR SIR : — The contract made by the Commonwealth, through its Board of Metropolitan Sewerage Commissioners, with the city of Boston, by its superintendent of streets, on the sixteenth day of April, 1892, for the reception of sewage from the Charles River valley system, so called, into the trunk sewer of said city at the junction of Huntington Avenue and Gainsborough Street, and the discharge of the same at the outlet at Moon Island, will expire on January 1 next (Jan. 1, 1896). It becomes necessary for this Board, by the provisions of chapter 439 of the Acts of 1889, to submit to the treasurer of the Commonwealth in the near future an estimate of the expenses of operating the said system of sewage disposal for the succeeding five years (1896 to 1900, inclusive). Will you kindly designate some one to consult with this Board, for said city, in relation to a new contract for the years mentioned, that we may know the amounts necessary to be raised to accomplish such disposal.

For the Board,
Yours very truly,
(Signed) EDWARD P. FISK,
Clerk.

In reply to this a communication was received, as follows: —

OFFICE OF THE SUPERINTENDENT OF STREETS,
ROOM 47, CITY HALL, BOSTON, Jan. 30, 1895.

DEAR SIR: — Your communication of January 19, addressed to His Honor the mayor, has been received, and the matter will have proper attention.

Yours truly, B. T. WHEELER,
Superintendent of Streets.

MR. EDWARD P. FISK,
Clerk Metropolitan Sewerage Commissioners, 110 Boylston Street.

To this the following reply was duly sent: —

COMMONWEALTH OF MASSACHUSETTS,
METROPOLITAN SEWERAGE COMMISSIONERS, 110 BOYLSTON STREET,
BOSTON, Feb. 6, 1895.

B. T. WHEELER, Esq.,
Superintendent of Streets, City Hall, Boston, Mass.

DEAR SIR: — Your communication of the 30th ult., stating that His Honor the mayor had referred to you the letter of this Board, dated Jan. 19, 1895, came duly to hand. As this Board is required by law to communicate to the State treasurer the amount required per annum for operating the Charles River valley system of sewerage for the years 1896 to 1900, inclusive, it is desirable that we know, at an early date, the amount that the city of Boston will require to receive sewage from said system into its main sewer at the junction of Gainsborough Street and Huntington Avenue, and discharge the same at the outlet at Moon Island. This Board would be glad to have a consultation with you at its meeting on Saturday next, February 9, some time between 10 and 12 o'clock, in relation to the matter.

For the Board,
Yours very truly,
(Signed) EDWARD P. FISK,
Clerk.

The following communication was received in reply: —

STREET DEPARTMENT, CITY HALL,
OFFICE OF THE SUPERINTENDENT, ROOM 47,
BOSTON, Feb. 7, 1895.

Mr. EDWARD P. FISK,
Clerk Metropolitan Sewerage Commissioners, 110 Boylston Street.

DEAR SIR: — You may say to the commissioners that I shall be pleased to meet them next Saturday, at about 10.30 A.M., and explain to them the necessity of reasonable time being allowed for the collection of data on which to base our estimate of what the State should pay for its use of our improved sewerage for the next five years.

Very truly yours,
(Signed) B. T. WHEELER,
Superintendent of Streets.

On Saturday, Feb. 9, 1895, the superintendent of streets met the Board by appointment, and stated that the subject of receiving sewage from the Charles River valley system was being investigated, and would be reported upon at as early a day as possible. There the matter has rested, and negotiations are still pending, with this end in view.

The negotiations pending when our last annual report was made regarding the various parcels of land belonging to the Boston & Albany Railroad at various points along their line in Boston and Newton were amicably settled without the intervention of the court. The said road, by deed dated Oct. 4, 1894 (recorded Suffolk Deeds, book 2230, page 446), releases and discharges the Commonwealth, its officers, agents and servants from all suits, actions, claims and demands by reason of the takings made by this Board at three different times. This deed covers all the land of said company on this line, lying within Suffolk County; and auxiliary to it is a deed from Eben D. Jordan of Boston, assigning to said company all rights and claims of every kind against the Commonwealth, on account of the taking made in Beacon Park (Brighton). This last deed is recorded with Suffolk Deeds, book 2230, page 465.

The same company, by a deed dated Oct. 4, 1894, releases the Commonwealth, its officers, agents and servants for expenses or compensation by reason of rights taken in land in Newton. This deed is recorded in Middlesex South District Deeds, book 2311, pages 545 and 548, and it also embraces land of the said company lying in Everett, upon the north metropolitan system.

This leaves the following cases still pending in court at this date (October 1): Suffolk County: Butchers' Slaughtering and Melting Association, Brighton; John E. Cassidy, Brighton. Middlesex County: John E. Cassidy, Newton; Walter U. Lawson, Newton; Albert Brackett, Newton.

The following connections have been made with this system during the year: —

Connections made with the Metropolitan Sewer in the Charles River Valley from Oct. 1, 1894, to Sept. 30, 1895.

DATE AUTHORIZED.	City or Town.	Location of Connection.	Size.	Date of Connection.
Nov. 17, 1894,	Boston (Brighton),	Corner North Harvard and Spurr streets, ...	18 inch,	Nov. 20, 1894.
July 20, 1895,	Boston, .	Corner Huntington Avenue and Bryant Street, on the south side of the metropolitan sewer, ...	24 inch, brick,	Sept. 19, 1895.
July 20, 1895,	Boston, .	Corner Huntington Avenue and Bryant Street, on the north side of the metropolitan sewer, ...	12 inch,	Sept. 26, 1895.

These, with the connections previously reported, show thirty-three connections made with the metropolitan sewer by the towns and cities embraced within this system, which are distributed as follows: Boston, nine; Brookline, one; Boston (Brighton), twelve; Watertown, four; Newton, six; Waltham, one; total, thirty-three.

The expenditures upon this system, including all payments on account of contracts during the twelve months ending Sept. 30, 1895, but not including expenses of operation (which are particularly stated in Table D of the Appendix), amount to $1,927.35. This, with the amount previously reported, $734,038.43, makes $735,965.78 as the total expenditures to date.

Your attention is called to tables submitted herewith for matters of detail.

During the year $302.20 has been expended that is chargeable to both systems in general, which amount, added to that formerly reported, $44,645.02, makes $44,947.22 so spent to this date. The expenditures of this Board to date may be stated concisely thus: —

North metropolitan system,	$4,556,204 92
Charles River valley system,	735,965 78
Both systems,	44,947 22
Total,	$5,337,117 92
Engineering, administrative and contingent expenses,	180,125 74
Total expenditures to date, on both systems,	$5,517,243 66

The commission appointed in 1891 to apportion the expenses of construction and maintenance on the two systems in their report filed in the supreme court that year state that they determine fifteen per cent. of the whole cost of construction to be the proportion chargeable to the Charles River system and eighty-five per cent. to the north metropolitan. Experience has shown these proportions to be approximately correct. We accordingly divide the engineering, administrative and contingent expenses, and the charge to both systems on that basis, as follows: —

North metropolitan, amount charged to date, as above,		$4,556,204 92
Both systems, amount to date,	$44,947 22	
Engineering expenses, etc.,	180,125 74	
Eighty-five per cent. of	$225,072 96=	191,312 02
Total, north metropolitan,		$4,747,516 94
Charles River, amount charged to date,	$735,965 78	
Fifteen per cent. of $225,072 96=	33,760 94	
		769,726 72
Grand total,		$5,517,243 66

NEPONSET RIVER VALLEY SYSTEM.

At its meeting on May 31, 1895, the following communication was laid before this Board and placed on file : —

COMMONWEALTH OF MASSACHUSETTS,
OFFICE OF THE SECRETARY, BOSTON, May 27, 1895.

To the Board of Metropolitan Sewerage Commissioners,
110 Boylston Street, Boston, Mass.

GENTLEMEN : — I have the honor to inform you that the act to provide for a system of sewage disposal for the Neponset River valley, being chapter 406 of the Acts of the year 1895, has been approved by His Excellency the governor, and is now in full force and effect.

Very respectfully,
(Signed) WM. M. OLIN,
Secretary.

At its meeting on June 5, the Board

Voted, To enter upon the work of construction of the system of sewage disposal for the Neponset River valley, as authorized by chapter 406, Acts of 1895.

Section 1 of said act is as follows : —

The board of metropolitan sewerage commissioners, constituted under the authority of chapter four hundred and thirty-nine of the acts of the year eighteen hundred and eighty-nine, shall, for the purpose of constructing, maintaining and operating a system of sewage disposal for the city of Boston and the towns of Dedham, Hyde Park and Milton, construct, maintain and operate such main sewers and other works as said board shall deem necessary for carrying out said purposes, in accordance with such plans as the said board or a majority thereof may approve and adopt, subject to the approval of the state board of health, may take by purchase or otherwise and use as part of said main sewers, the sewer or part of sewer now or hereafter built by the city of Boston between Granite bridge, so called, and Central avenue in the Dorchester district of said Boston. Said board, for the purposes aforesaid, may make all contracts necessary for the construction of the sewers and works aforesaid, and may, where deemed advisable, carry on said construction by day labor.

In accordance with this act, the engineering department was set at work to determine the most advantageous course for the line of said sewer to follow, a study having been made by the city engineer of Boston (City Document 195, 1894). This was taken as a basis, and at the meeting of this Board, held Sept. 21, 1895, the chief engineer submitted his report, with plans for the same, the consideration of which this Board deferred for one week, and upon Sept. 28, 1895, —

Voted, That the report of Wm. M. Brown, Jr., chief engineer, with the accompanying plans and profiles, for a system of sewage disposal for the Neponset River valley, be approved and adopted by this Board.

Voted, That the same be submitted to the State Board of Health for its approval, in accordance with the provisions of chapter 406 of the Acts of 1895.

In accordance with the above votes, the following report, with accompanying plans (a copy of which is shown on the accompanying map), were forwarded to the State Board of Health with the following letter: —

COMMONWEALTH OF MASSACHUSETTS,
METROPOLITAN SEWERAGE COMMISSIONERS, 110 BOYLSTON STREET,
BOSTON, MASS., Oct. 9, 1895.

To the Honorable the State Board of Health,
State House, Boston, Mass.

GENTLEMEN: — By vote of this Board I transmit herewith the report of our chief engineer, William M. Brown, Jr., on a plan providing a system of sewage disposal for that portion of the city of Boston, together with the towns of Milton, Hyde Park and Dedham, lying within the valley of the Neponset River, with the plans of the same. This is submitted for your approval in accordance with the provisions of section 1, chapter 406, Acts of 1895, and was approved and adopted by this Board at its meeting on Sept. 28, 1895. This Board, or its engineer, will be glad to furnish any further information you may require, or explain any of the plans and papers submitted herewith.

For the Board,
Very respectfully yours,
(Signed) EDWARD P. FISK,
Clerk.

The report and plan of our chief engineer follow: —

ENGINEER'S REPORT.

HOSEA KINGMAN, TILLY HAYNES, ALBERT F. NOYES,
Metropolitan Sewerage Commissioners.

GENTLEMEN: — In compliance with your request, I have prepared a study for an intercepting sewer in the Neponset River and Mother Brook valleys, designed to receive foul drainage for Dedham, Hyde Park, Milton, parts of the city of Boston and other areas. I have also considered the question of disposal for this drainage through the main drainage system of the city of Boston, or elsewhere, substantially as outlined in Acts of 1895, chapter 406, and submit the following report in relation thereto.

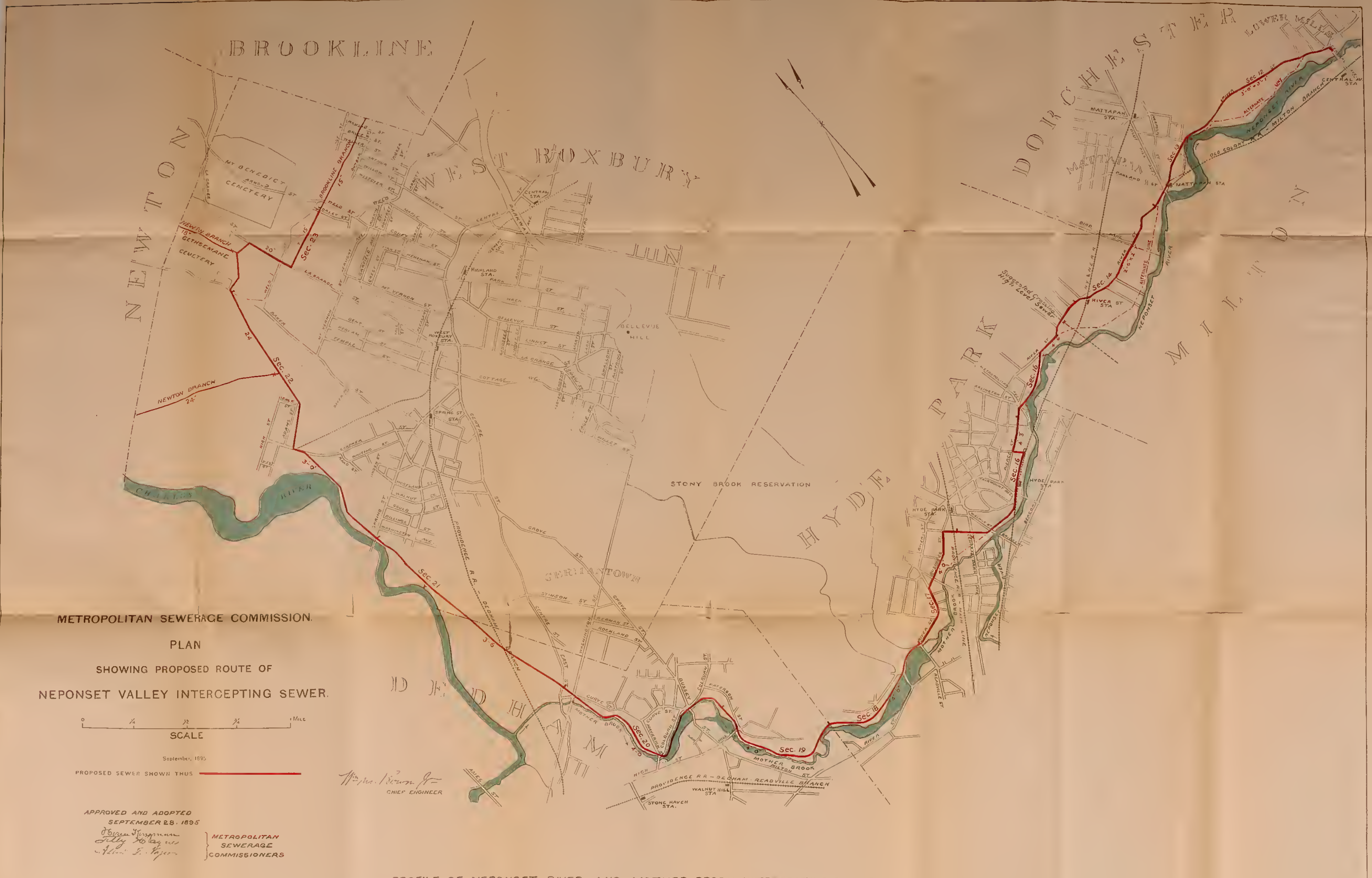
REPORT ON AN INTERCEPTING SEWER FOR NEPONSET RIVER AND MOTHER BROOK BASINS.

Areas, Populations and Quantities of Sewage anticipated.

The main sewers of the north metropolitan system have been designed to meet the requirements of an anticipated population, 1930. It is believed to be sufficient in this study to provide for populations at that date. Chapter 406 of the Acts of 1895 specifies that provision be made for Dedham, Hyde Park, Milton, the city of Boston (presumably referring to areas in West Roxbury and Dorchester). This district is all within the Neponset, Mother Brook and Charles River basins, except one small area in Hyde Park in the Stony Brook basin, near Clarendon Hills, which can readily be drained through the divide, and this has been included in the study. Small areas in Newton and Brookline find a natural outlet for drainage through these basins. They have also been provided for in the study.

The towns of the upper Neponset valley, Walpole, Stoughton, Sharon, Canton and Norwood, find a natural outlet for drainage in an intercepting sewer in the Neponset valley, passing Hyde Park. This drainage can readily be collected, and a system of intercepting sewers for this purpose extending to Hyde Park would cost probably $400,000.

These towns have no sewerage systems, and it will probably be a number of years before any sewers are built. Areas of land near the towns available for local land treatment make it probable that this will be found the cheaper and more desirable disposal.



METROPOLITAN SEWERAGE COMMISSION.

PLAN

SHOWING PROPOSED ROUTE OF

NEPONSET VALLEY INTERCEPTING SEWER.

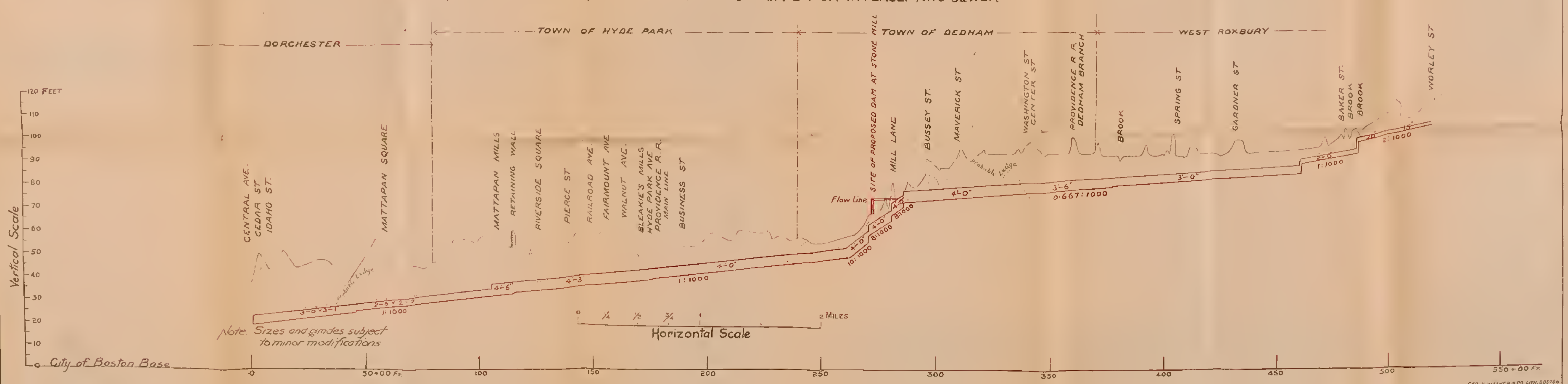
0 ¼ ½ ¾ 1 Mile
SCALE

September, 1895

PROPOSED SEWER SHOWN THUS

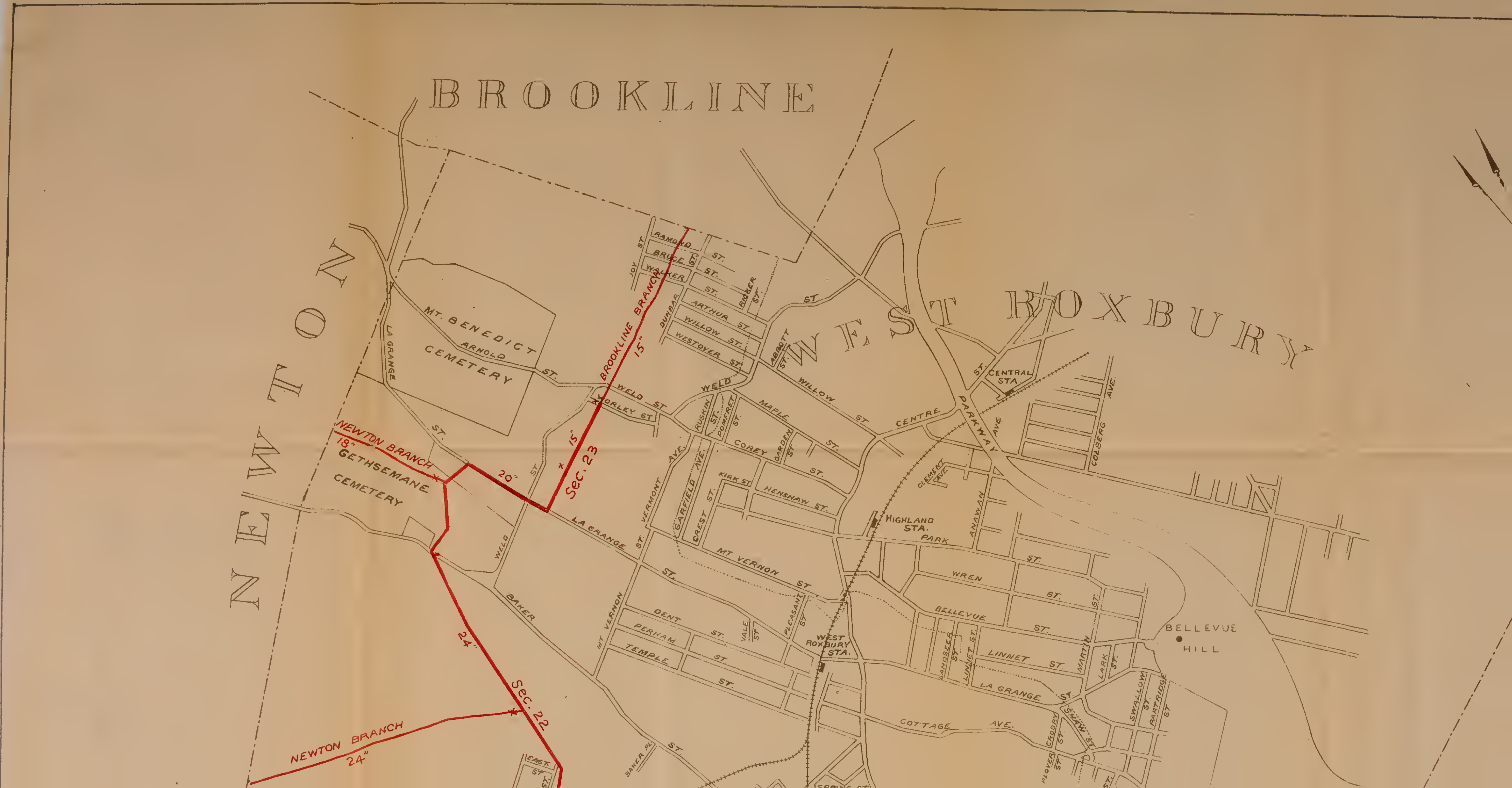
APPROVED AND ADOPTED
SEPTEMBER 28. 1895
Hosea Kingman
Tilly Haynes
Albert F. Upham
} METROPOLITAN SEWERAGE COMMISSIONERS

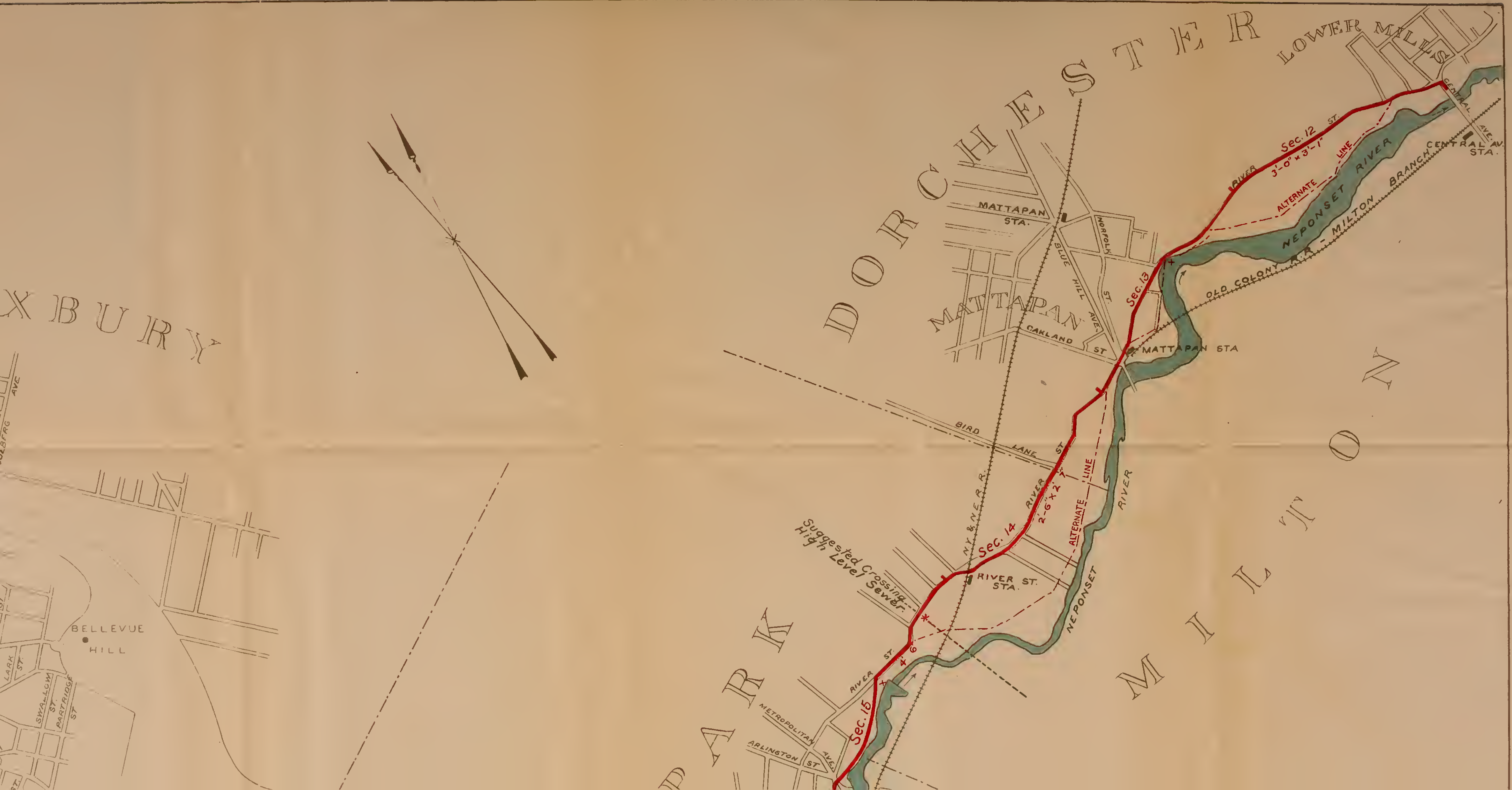
PROFILE OF NEPONSET RIVER AND MOTHER BROOK INTERCEPTING SEWER

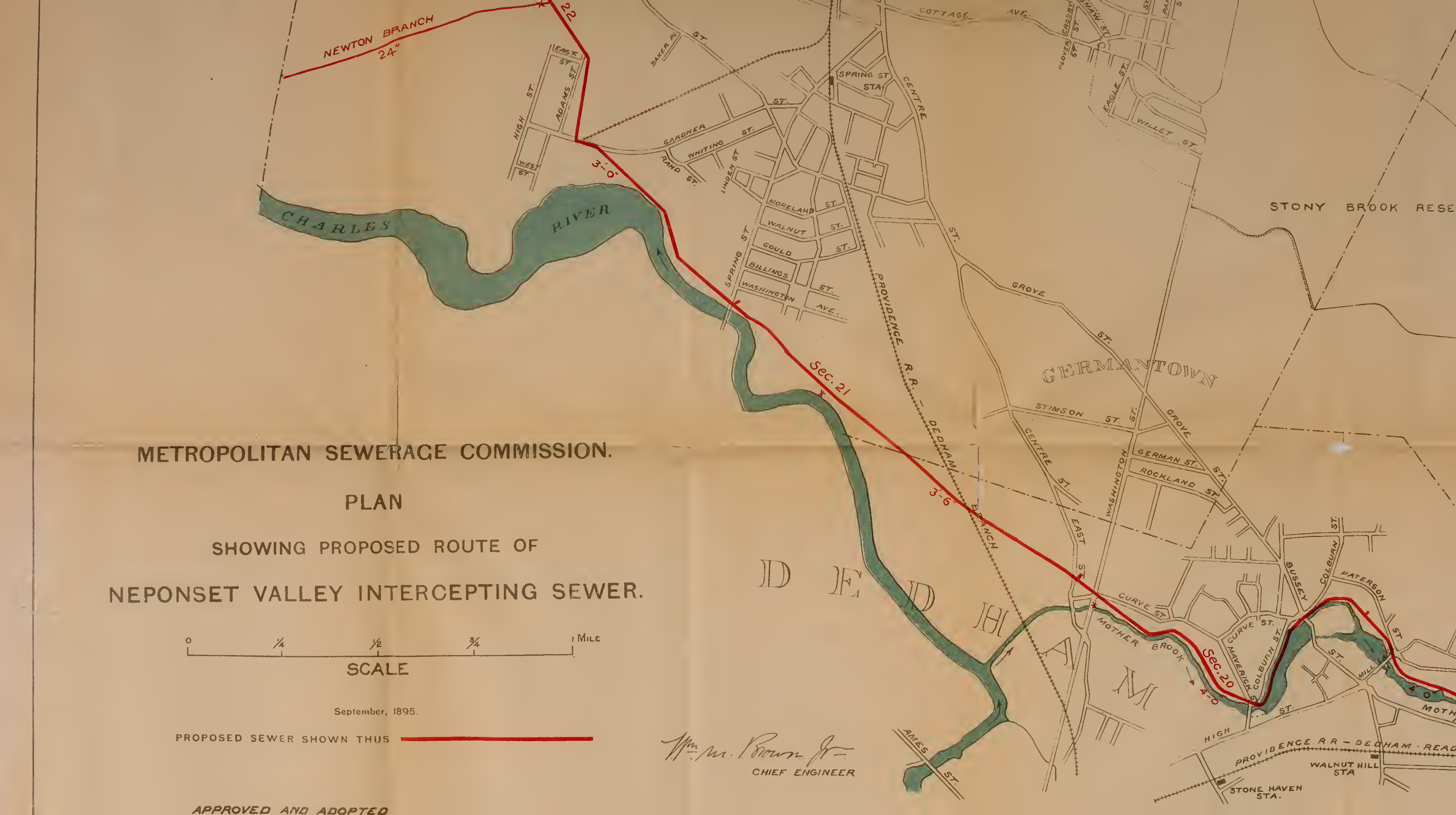


Note. Sizes and grades subject to minor modifications

GEO. H. WALKER & CO. LITH. BOSTON


BROOKLINE
NEWTON
WEST ROXBURY
BROOKLINE BRANCH
15"
Sec. 23
NEWTON BRANCH
18"
20"
24"
Sec. 22
NEWTON BRANCH
24"
MT. BENEDICT CEMETERY
GETHSEMANE CEMETERY
ARNOLD ST.
LA GRANGE ST.
WELD ST.
MORLEY ST.
RAMOND ST.
BRUCE ST.
WALKER ST.
JOY ST.
BAKER ST.
ARTHUR ST.
WILLOW ST.
WESTOVER ST.
DUNBAR
ABBOTT ST.
RUSKIN
POMFRET ST.
MAPLE ST.
COREY ST.
GARDEN ST.
CENTRE ST.
PARKWAY
AVE.
CENTRAL STA.
COLBERG AVE.
CLEMENT AVE.
ANAWAN AVE.
HIGHLAND STA.
PARK
KIRK ST.
HENSHAW ST.
VERMONT ST.
GARFIELD AVE.
CREST AVE.
MT VERNON ST.
WREN ST.
BELLEVUE ST.
BELLEVUE HILL
DENT ST.
PERHAM ST.
TEMPLE ST.
YALE ST.
PLEASANT ST.
WEST ROXBURY STA.
LANDSEER ST.
LINNET ST.
MARTIN ST.
LARK ST.
SWALLOW ST.
PARTRIDGE ST.
SHAW ST.
CROSBY ST.
PLOVER ST.
COTTAGE AVE.
BAKER PL.
EAST ST.
SPRING ST.


DORCHESTER
LOWER MILLS
XBURY
MATTAPAN
MILTON
PARK
Sec. 12
3'-0" x 3'-1"
RIVER ST.
ALTERNATE LINE
NEPONSET RIVER
CENTRAL AVE.
CENTRAL AV. STA.
OLD COLONY R.R. - MILTON BRANCH
MATTAPAN STA.
Sec. 13
BLUE HILL AVE.
NORFOLK ST
OAKLAND ST
MATTAPAN STA
BIRD LANE ST
RIVER ST
2'-6" x 2'-7"
ALTERNATE LINE
RIVER
Sec. 14
NY & NE R.R.
RIVER ST. STA.
Suggested Crossing High Level Sewer
NEPONSET RIVER
4'-6"
RIVER ST.
Sec. 15
METROPOLITAN AVE
ARLINGTON ST
BELLEVUE HILL
LARK ST
SWALLOW ST
PARTRIDGE ST
AVE



METROPOLITAN SEWERAGE COMMISSION.

PLAN

SHOWING PROPOSED ROUTE OF

NEPONSET VALLEY INTERCEPTING SEWER.

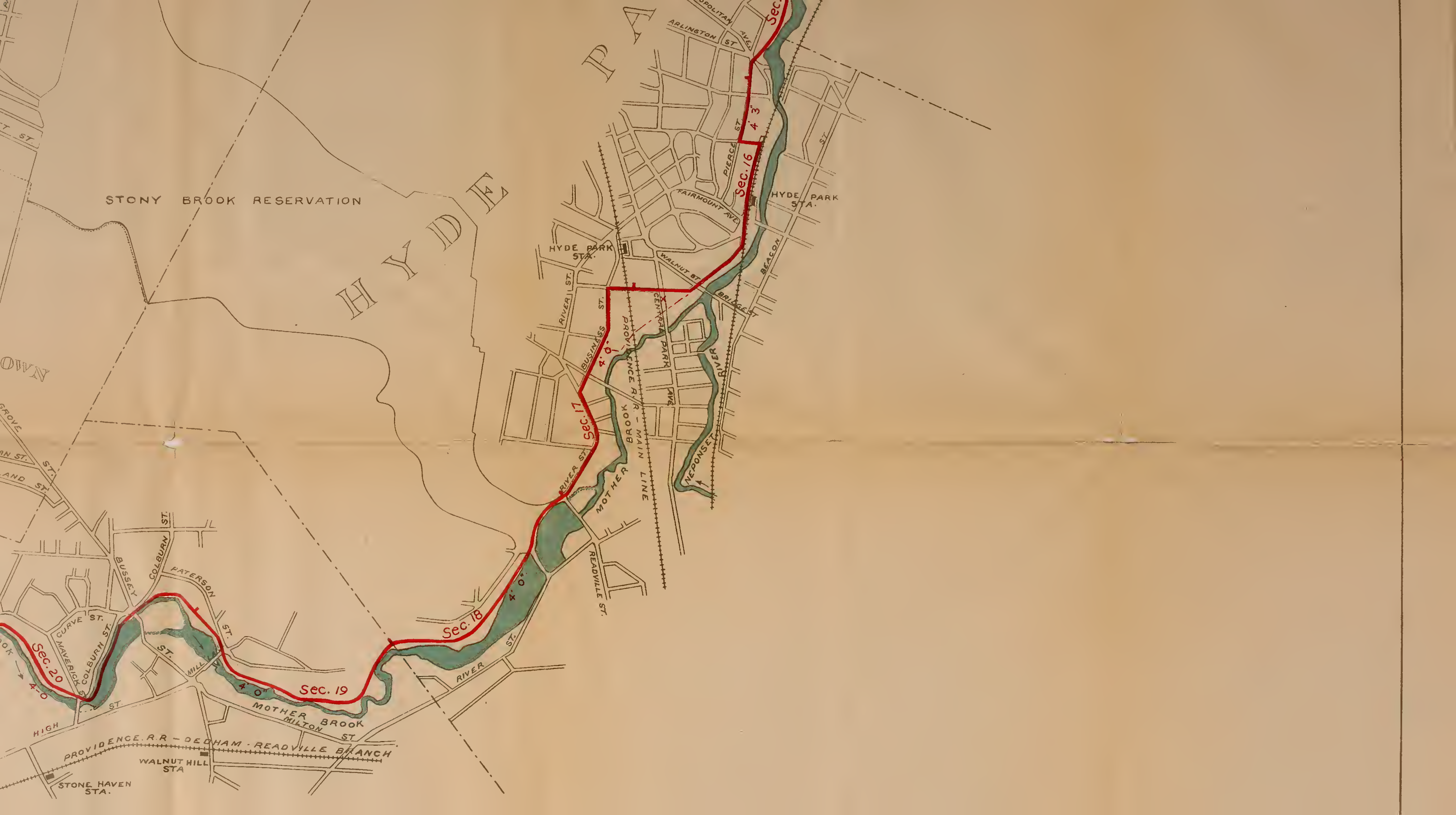
SCALE

September, 1895.

PROPOSED SEWER SHOWN THUS

Wm. M. Brown Jr.
CHIEF ENGINEER

APPROVED AND ADOPTED


STONY BROOK RESERVATION
HYDE PA
OWN
ST.
GROVE
AN ST.
AND ST.
ST.
OPOLITAN AVE.
ARLINGTON ST.
Sec.
4' 3"
PIERCE ST.
Sec. 16
HYDE PARK STA.
FAIRMOUNT AVE.
HYDE PARK STA.
WALNUT ST.
BRIDGE ST.
BEACON
ST.
RIVER ST.
ST.
BUSINESS
4' 0"
PROVIDENCE R.R. – MAIN LINE
CENTRAL PARK AVE.
NEPONSET RIVER
Sec. 17
RIVER ST.
MOTHER BROOK
READVILLE ST.
4' 0"
Sec. 18
RIVER ST.
COLBURN ST.
PATERSON ST.
BUSSEY
CURVE ST.
MAVERICK
COLBURN ST.
ST.
MILL ST.
4' 0"
Sec. 19
Sec. 20
4-0
OK
MOTHER BROOK
MILTON ST.
HIGH ST.
PROVIDENCE R.R – DEDHAM – READVILLE BRANCH
WALNUT HILL STA
STONE HAVEN STA.

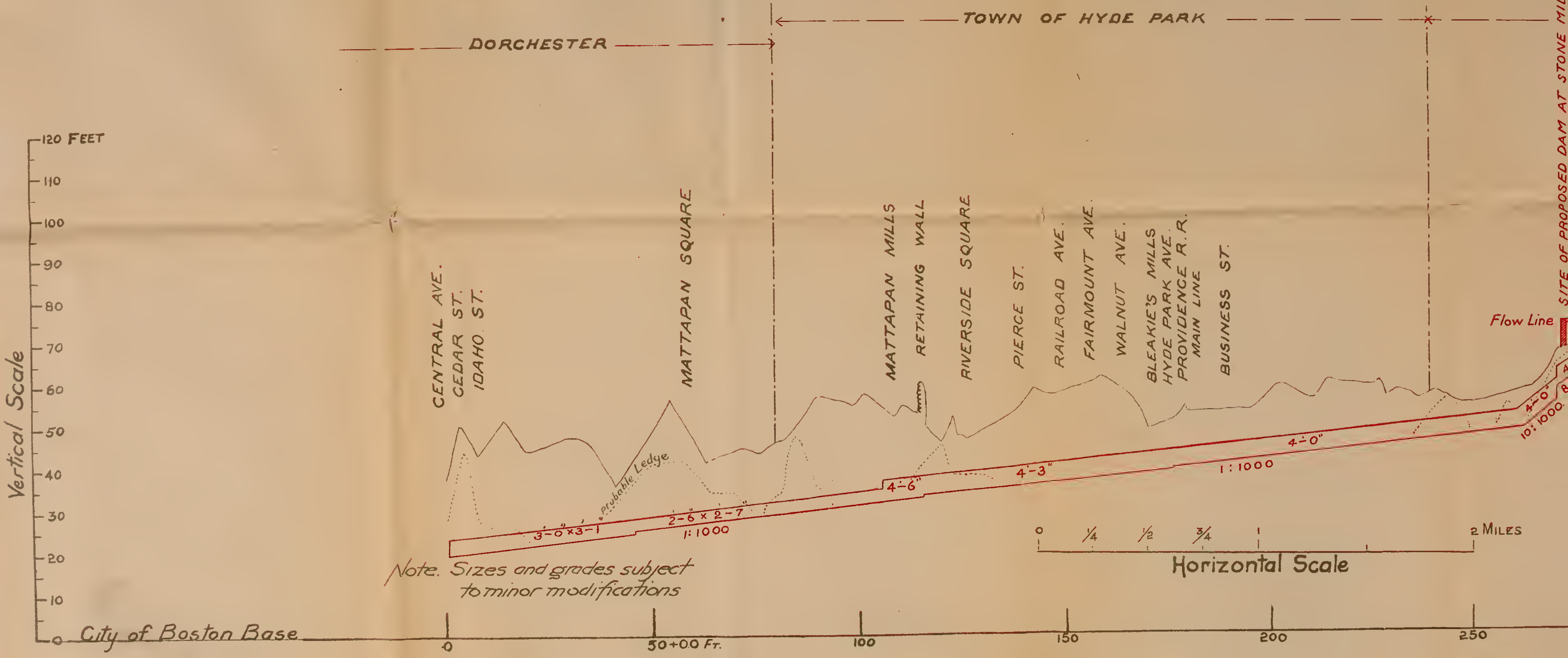
PROPOSED SEWER SHOWN THUS

Wm. M. Brown Jr.
CHIEF ENGINEER

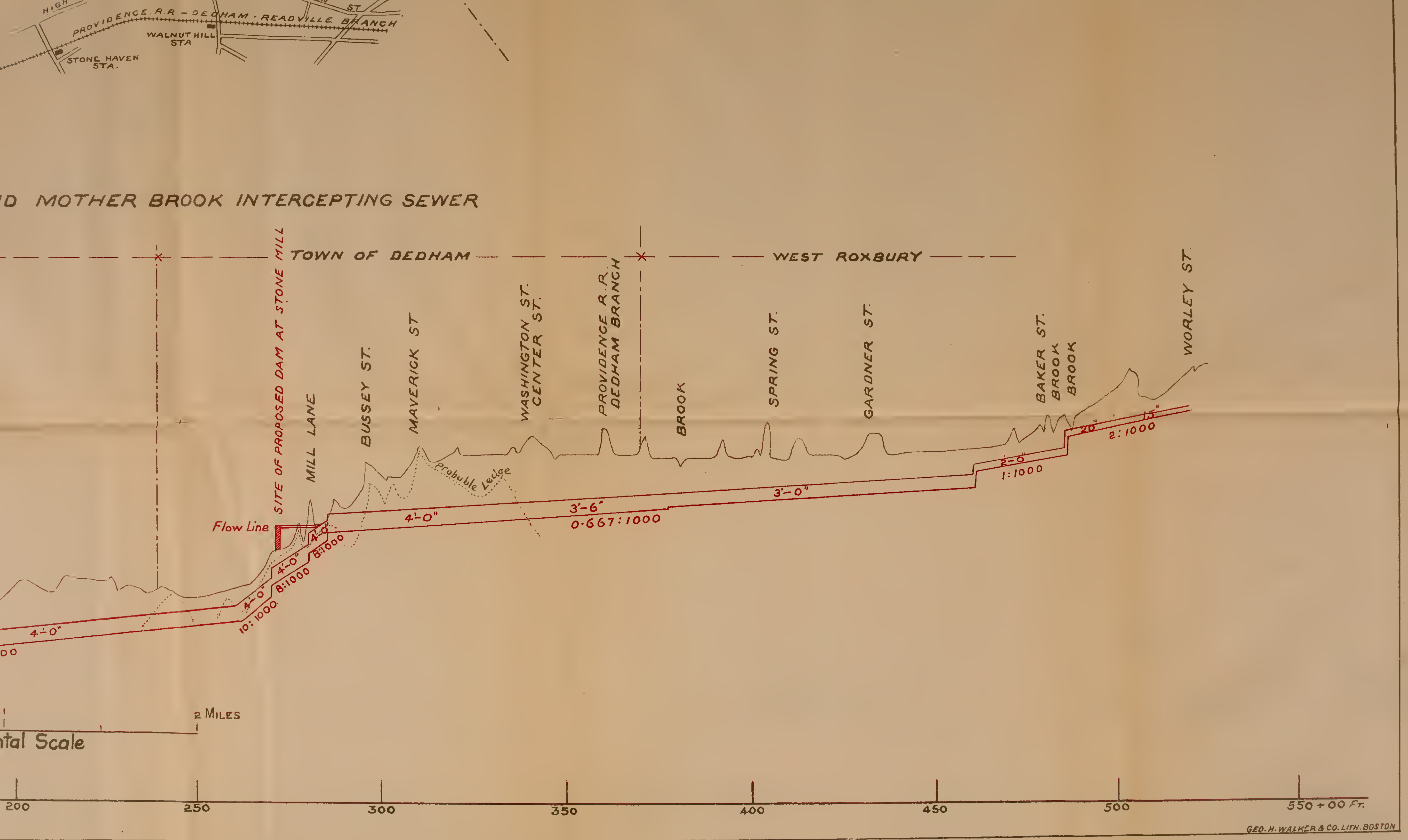
APPROVED AND ADOPTED
SEPTEMBER 28. 1895

Hosea Kingman
Tilly Haynes
Albert F. Noyes
} METROPOLITAN SEWERAGE COMMISSIONERS

PROFILE OF NEPONSET RIVER AND MOTHER BROOK INTE



Note. Sizes and grades subject to minor modifications


HIGH
PROVIDENCE R.R. – DEDHAM · READVILLE BRANCH
ST
WALNUT HILL STA
STONE HAVEN STA.
D MOTHER BROOK INTERCEPTING SEWER
TOWN OF DEDHAM
WEST ROXBURY
SITE OF PROPOSED DAM AT STONE MILL
MILL LANE
BUSSEY ST.
MAVERICK ST
WASHINGTON ST.
CENTER ST.
PROVIDENCE R.R.
DEDHAM BRANCH
BROOK
SPRING ST.
GARDNER ST.
BAKER ST.
BROOK
BROOK
WORLEY ST.
Flow Line
Probable Ledge
4'-0"
00
4'-0"
10:1000
4'-0"
8:1000
4'-0"
8:1000
4'-0"
3'-6"
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3'-0"
2'-0"
1:1000
20"
15"
2:1000
2 MILES
ntal Scale
200
250
300
350
400
450
500
550 + 00 FT.
GEO. H. WALKER & CO. LITH. BOSTON

It has not seemed wise to make any provision for these towns in the design for the Neponset valley intercepter. The matter can be again studied when the high-level sewer of the Boston main drainage system is built, which it is anticipated will be required not later than 1905.

The areas considered in this study are outlined on the accompanying map in red.

The Newton and Brookline areas are without sewers, sparsely settled, remote from railroad connection, and will doubtless develop slowly; an ultimate provision for 5 persons per acre has been provided.

The West Roxbury area involves something more than one-third the habitable portion of West Roxbury. It is developing rapidly, has good railroad connections, and, although at present without sewers, may shortly be provided with drainage in the Spring Street and other areas.

Provision has been made in the Spring Street area for 30 persons per acre, and a somewhat less number in other areas, aggregating 23 persons per acre over the whole area.

Dedham is at present without sewers, but is preparing a study for a system for the areas near the centre of the town. There are large unoccupied areas which will be sparsely settled for a very long time. Provision has been made for the centre of the town at the rate of about 30 persons per acre, with an aggregate of 6 per acre over the whole area.

Hyde Park is at present without sewers. A study is about to be made for a system to cover the central area, which is fast approaching the density of an urban population. A provision has been made for about 30 persons per acre in the central area, with a somewhat less allowance on the outlying districts, aggregating 18 persons per acre over the whole area.

Milton has provided a careful study for a system of sewers, prepared by George A. Kimball, consulting engineer, which has been approved by the State Board of Health. This provides for about 5 persons per acre over the whole area, and has been adopted in this study.

The Dorchester area to Central Avenue, near Mattapan, has been provided for at the rate of 40 persons per acre. It is growing rapidly, has already a large population, and is fast assuming the condition of a crowded city area.

The populations suggested above are somewhat more liberal than provided by the city engineer of Boston in his recent study of these areas (see City Document 195, 1894, page 4). They are, however, not specially larger than provided in metropolitan sewerage areas for similar districts, and are substantially the same as suggested in studies for metropolitan water supply for the same areas.

The table below presents a comparison of populations above noted: —

Table of Areas and Estimated Population, 1930.

LOCATION.	Area, Acres.	City Engineer's Estimate	Estimate Metropolitan Water Supply.	Estimate for Neponset Intercepter.
Brookline, . . .	1,262	-	-	5,000
Newton, ...	2,835	8,000	-	15,000
West Roxbury, . .	2,382	24,500	47,000†	55,312
Dedham,* . . .	2,566	15,300	34,000†	34,000
Hyde Park, . . .	2,410	28,000	43,600	43,600
Dorchester, . . .	785	24,000	30,000†	31,404
Milton, ...	6,624	5,000	25,100	29,000
Totals, . . .	21,864	104,800	-	213,316

* Dedham population estimated on same basis as metropolitan water supply.
† Estimated.

In studies for metropolitan sewerage an allowance of 30 cubic feet per head per day was used as a maximum, on areas of this character, in determining the quantities of sewage to be anticipated in 1930. This rate involves liberal allowances for infiltration of ground water, for manufacturing wastes and public uses of water. Recent measurements of deliveries in the Charles River branch of this system, which has been in operation about four years, indicate that the quantities anticipated have been exceeded by less than one per cent.

The manufacturing use of water in the Neponset and Mother Brook basins is large, — much beyond the average. Only a small percentage of water actually used, however, is sufficiently polluted to need removal through the sewers. The accompanying table indicates the very large use of water in the manufactories, together with an estimate of probable quantities of manufacturing wastes to be provided for: —

Table showing Estimated Quantity of Water used in Manufactories, also Estimated Quantities of Manufacturing Wastes for which Provision must be made.

Name of Factory.	Location.	Quantities of Water used (Gallons in 24 Hours).	Estimated Quantities Manufacturing Waste for which Provision should be made in Sewer (Gallons in 24 Hours).
Tileston & Hollingsworth Co., Eagle Mill (paper mill),	Central Avenue, Mattapan,	3,000,000	–
Tileston & Hollingsworth Co.,	Mattapan,	7,000,000	–
Horatio N. Glover & Son (starch factory),	Mattapan,	–	–
Boston Gossamer Rubber Company (rubber factory),	River Street station,	1,000	–
Tileston & Hollingsworth Co. (Mattapan Mills, paper),	River Street station,	6,000,000	–
Robert Bleakie & Co. (cloth and wool scouring),	Hyde Park Avenue, Hyde Park,	1,300,000	9,000
American Tool and Machine Company (machine shop and foundry),	Hyde Park Avenue, Hyde Park,	–	–
T. H. Gray (shoddy mill),	Bank Neponset River, Hyde Park,	650,000	35,250
Wilton Mills (wool washing),	Bank Neponset River, Hyde Park,	1,000,000	7,500
B. B. & R. Knight (Readville cotton mill),	Upper Mill Pond, Hyde Park,	–	–
Norfolk Mill (scouring yarn),	East Dedham,	750,000*	9,750
Merchant's Woollen Mill (wool and cloth scouring),	East Dedham,	200,000	37,500
Totals,		19,901,000	99,000

* Estimated.

In the rate of 30 cubic feet per head per day an allowance of 25 gallons per capita is made for manufacturing wastes. This, on the population of 213,000 estimated above, gives an allowance of 5,300,000 gallons, or 25 per cent. of the total water used by the large manufactories, which is believed to be ample. Thirty cubic feet per head per day has, therefore, been adopted in this study as a safe allowance for use in sizing sewers in the Neponset valley.

The table below indicates the accumulated sewage from anticipated populations, 1930, at this rate of 30 cubic feet per head per day: —

Quantities of Sewage anticipated, 1930.

Town.	Area, Acres.	Estimated Population, 1930.	Quantities at 30 Cubic Feet per Head per Day (Cubic Feet per Second).	Totals (Cubic Feet per Second).
Brookline,	1,262	5,000	1.737	1.737
Newton,	2,835	15,000	5.208	6.945
West Roxbury,	2,382	55,312	19.205	26.250
Dedham,	5,566	34,000	11.805	37.955
Hyde Park,	2,410	43,600	15.139	53.094
Dorchester,	785	31,404	10.904	63.998
Milton,	6,624	29,000	10.069	74.067

Disposal.

Three available methods of disposal are suggested, viz., through the main drainage system of the city of Boston, — first, in the Dorchester intercepter now built to Central Avenue, near Mattapan; second, in the high-level sewer from Squantum (not yet built); and last through an independent outlet at Nut Island in Quincy.

Disposal in the Dorchester Intercepter.

The sewer as now built to Central Avenue, near Mattapan, is 2 feet 4 inches by 3 feet 6 inches, egg-shaped, having a carrying capacity of 26 cubic feet per second. Its carrying capacity at Baker's Court, some distance below, is only 20 cubic feet per second. This must be regarded as governing the capacity of the main at Central Avenue. To determine the period during which the Neponset valley system might discharge through the Dorchester intercepter, it is assumed that in 1900 the Neponset intercepter will have been built and local systems discharging into it at the following rate: —

TOWN.	Census, 1895.	Tributary in 1900 to Neponset Valley.	Assumed Sewage at 30 Cubic Feet per Head per Day (Cubic Feet per Second).	Totals (Cubic Feet per Second).
Newton (Ward 5), . .	3,159	500	0.17	–
Brookline (whole), . .	16,159	500	0.17	0.34
West Roxbury (Ward 23),	18,233	2,000	0.70	1.04
Dedham, ...	7,218	5,000	1.74	2.78
Hyde Park, . . .	11,828	11,000	3.82	6.60
Milton, ...	5,518	4,000	1.40	8.00
Dorchester (Ward 24), .	18,188	4,000	1.40	9.40
	–	27,000	9.40	–

To arrive at the ultimate quantity of 74 cubic feet per second in 1930, outlined above, it is assumed that the increase will be uniform from 1900, or at the rate of 2.2 cubic feet per second each year. This gives 20.4 cubic feet per second as the anticipated quantity, 1905, or the full capacity of the Dorchester intercepter. It thus appears that the Neponset valley can find an outlet for drainage into the Dorchester intercepter until about 1905.

Disposal through High-level Sewer of Boston Main Drainage System.

In the construction of the main drainage works a nine-foot branch was built into the trunk sewer east of the tunnel, at Squantum. Its water line is fourteen feet above low water, and the purpose was to extend a gravity sewer from the branch along the high lands of Milton or elsewhere to intercept the drainage from high levels in the area bounded by Charles River, Mother Brook and Neponset River, for the relief of which the main drainage system was designed.

A possible route for the high-level sewer from Squantum to its point of crossing the Neponset main in Hyde Park, near the Dorchester line, is indicated on the accompanying map, together with high-level areas that might be tributary to it. It is not unlikely that this would be built as early as 1905, in which case the Neponset intercepter could find an outlet into it after that date. Under this arrangement the Neponset main would be built to its junction with the high-level sewer with its ultimate capacity.

Below this junction to Central Avenue, near Mattapan, it would be built with a carrying capacity of 20 cubic feet. After 1905 this reduced section through Dorchester would serve permanently for low levels in Dorchester and Milton. An approximate estimate of cost for the high-level sewer from Squantum to Hyde Park is as follows: —

Cost of High-level Sewer from Hyde Park Intercepter to Squantum.

39,200 linear feet brick sewer = 43,628 cubic yards at $15,	$654,420
35,700 linear feet earth excavation = 206,267 cubic yards at $1,	206,267
3,500 linear feet embankment = 70,350 cubic yards at $0.50,	35,175
200 linear feet tunnel at Neponset River at $50,	10,000
Brook crossings,	15,000
Rock excavation,	10,000
Right of way at $3 for three-fourths of $39,200,	29,400
	$960,262
Engineering and contingencies, 15 per cent.,	144,039
	$1,104,301

Boston's main drainage system was designed for the area bounded by Charles River, Mother Brook and Neponset River. Its ultimate capacity, as determined by the State Board of Health (see report on sewerage of Mystic and Charles River valleys, page 89), is 154,000,000 gallons per day. In the same report, from studies of population made in 1888, the Board of Health concludes that the Boston main drainage system possesses ample capacity for the drainage to 1930 of the area for which it was designed, and also for Waltham, Watertown, Dedham, Hyde Park and Milton. These determinations of populations were founded on the census of 1885. The census of 1890 (also of 1895) indicated these predictions to be small, and in designing the metropolitan main sewers these populations were increased ten to fifteen per cent.

The city of Quincy is now about to pump its sewage into the main drainage system at Squantum also. The following table gives a forecast of populations from 1905 to 1930 for the whole area tributary to main drainage, including the Neponset valley, as follows: Boston (city proper), South Boston, Roxbury, Dorchester, West Roxbury, Brighton, Brookline, Newton, Hyde Park, Quincy, Watertown, Waltham, Milton and Dedham, prepared on the same basis used in sizing metropolitan sewers: —

Table of Forecasts of Populations Tributary to Boston Main Drainage System on the Same Basis used in Sizing Metropolitan Sewers, viz., Prediction of State Board of Health of 1888, increased Ten to Fifteen Per Cent.

1895.	1900.	1905.	1910.	1915.	1920.	1925.	1930.
541,000	586,500	631,600	676,000	722,200	767,500	812,800	858,000

At the rate of 30 cubic feet per head per day, these populations would yield in gallons as follows: —

1895.	1900.	1905.	1910.	1915.	1920.	1925.	1930.
122,000,000	132,000,000	142,000,000	152,000,000	162,000,000	172,000,000	182,000,000	192,000,000

The study indicates that the ultimate capacity of 154,000,000 gallons, even on the conservative estimate of population used, will be attained not later than 1915.

The main sewer from Squantum to the outfall works has a carrying capacity running full of 266,990,000 gallons in twenty-four hours.

To provide outlet works after 1915 for the 112,000,000 gallons per day beyond the 154,000,000 gallons for which the present works were designed, will involve almost a duplication of existing storage reservoirs and discharge sewers.

The present storage reservoir on Moon Island holds 25,000,000 gallons. The State Board of Health has indicated that continuous discharge for four hours after ebb tide can safely be made (see report, 1888, page 88). This yields an average delivery with present reservoir of 3⅛ million gallons per hour, or 75,000,000 per twenty-four hours. The average daily pumpage at the main drainage works for 1894 was 71,000,000 gallons. The additional 25,000,000 gallons storage provided for in the original design of the works by enlarging the reservoir will therefore be needed as soon as the Neponset valley sewage is introduced, not later than 1900.

Disposal through Independent Outlet at Nut Island, Quincy.

Studies in connection with sewage disposal for the city of Quincy have disclosed the fact that strong tidal currents are found off Nut Island. Float experiments at four hours after ebb tide indicate these currents to be as efficient as at Moon Island. At four hours after ebb the surface of the sea is approximately three feet above low water. If storage reservoirs be constructed on Nut Island with water lines at five feet above low water, they would safely discharge moderate quantities of sewage during four hours after ebb.

A practical route for a trunk sewer from Nut Island to Hyde Park has been indicated on the accompanying map. A reasonable profile has been found. The sewer is designed to deliver without pumping into reservoir at Nut Island at five feet above low water, and is large enough to provide for the city of Quincy as well as the other towns in the valley. Quincy will be obliged to pump its low areas into it. An approximate estimate of cost for this sewer and outfall works from Nut Island to Hyde Park is given below: —

Approximate Estimate of Cost, Nut Island Outfall to Hyde Park.

52,700 linear feet brick sewer = 45,036 cubic yards at $15,	$675,540
52,700 linear feet excavation = 246,074 cubic yards at $1,	246,074
2,000 linear feet 36-inch ball and socket pipe at $30,	60,000
200 linear feet tunnel under Neponset River at $50,	10,000
Rock excavation,	15,000
Brook crossings,	5,000
Crossing Nut Island bar,	10,000
Reservoir at Nut Island,	150,000
Right of way at $3 per foot for three-quarters of $52,700,	118,575
	$1,290,189
Engineering and contingencies, fifteen per cent.,	193,528
	$1,483,717

As contrasted with Moon Island disposal, there are objections to the Nut Island scheme. The city of Quincy will strongly protest against it. The storage is at three feet lower elevation than at Moon Island. The line shown for the main trunk sewer is through a very fine residential area in Milton and Quincy. The whole cost and maintenance for the scheme will fall on the Neponset valley alone.

Conclusions.

The conclusions from the study are as follows: the Neponset valley can find an outlet for its drainage until about 1905 in the Dorchester intercepter of Boston main drainage system. After that date it will be best to co-operate with the city of Boston in constructing the high-level sewer from Hyde Park to Squantum, and that this outlet will be competent until about 1915, when duplicate outlet works will yield a safe disposal until after 1930.

The total cost of outfall works in connection with Boston main drainage system, in which the Neponset valley will share until 1930, is estimated as follows: —

High-level sewer, Hyde Park to Squantum,	$1,104,300
Main sewer, Squantum to Moon Island, and reservoir 50,000,000 gallons capacity,	1,000,000
Discharge channels,	100,000
Duplication of outfall after 1915,	750,000
	$2,954,300
Say	3,000,000

On the basis of population the cost to Neponset valley will be about $500,000, one-quarter of which will not be incurred until 1915. In case of failure to construct the high-level sewer when needed, a safe disposal can be found at Nut Island at an estimated cost of $1,483,700.

A route has been studied for the Neponset intercepter, and is indicated on the accompanying map. It varies somewhat from that proposed by the city engineer, in that it follows existing streets, avoiding private lands. After making due allowance for quantities and costs of land takings, it is no more expensive. An alternate route through private land is also indicated. If rights of way at reasonable costs can be secured over this route in advance of construction, it should be favorably considered. From Central Avenue, near Mattapan, to a point in Hyde Park near Mattapan Mills, where the high-level sewer is assumed to cross, it is given a carrying capacity of 20 cubic feet per second. Above that it is designed to provide on a liberal basis for anticipated populations in 1930. The accompanying table gives the data of costs, size, etc., by sections: —

Estimate of Cost by Sections of Mother Brook Intercepting Sewer.

Section.	STATION.	Length (Feet).	Size.	Cost of Structure.	Average Cut.	Cubic Yards Rock.	Cost of Excavation at $1 per Cubic Yard.	Cost of Rock Excavation at $4.50 per Cubic Yard.	Land Damages.	Total Cost plus 15 Per Cent. for Engineering and Contingencies.	Cost per Foot.
12	0 + 50 to 32 + 00 .	3,250	3′ 0″ x 3′ 1′	$13,650 00	23.2	3,500	$16,957	$15,750	-	$53,303	$16 40
13	32 + 00 to 64 + 00 .	3,200	3′ 0″ x 3′ 1″	13,440 00	13.5	4,400	16,811	19,800	-	57,559	18 00
14	64 + 00 to 100 + 00 .	2,000 1,600	2′ 6″ x 2′ 7″ 4′ 6″	7,500 00 9,600 00	17.3	1,950	18,344	8,775	-	50,840	14 12
15	100 + 00 to 134 + 89 .	1,500 1,989	4′ 6″ 4′ 3″	9,000 00 11,340 00	23.8	4,350	18,302	19,575	$8,000	76,149	21 82
16	134 + 89 to 168 + 00 .	3,311	4′ 3″	18,870 00	20.5	-	16,825	-	-	41,049	12 39
17	168 + 00 to 206 + 50 .	700 3,150	4′ 3″ 4′ 0″	3,990 00 17,010 00	12.5	-	10,064*	-	960	36,829	9 57
18	206 + 50 to 240 + 00 .	3,350	4′ 0″	18,090 00	12.5	1,550	7,488*	6,975	1,440	39,092	11 67
19	240 + 00 to 276 + 00 .	3,600	4′ 0″	19,440 00	8.5	2,531	8,989*	11,435	2,880	49,156	13 65
20	276 + 00 to 332 + 00 .	5,600	4′ 0″	18,225 00	16.1	7,000	9,115*	31,500	4,160	72,450	12 94
21	332 + 00 to 392 + 00 .	4,500 1,500	3′ 6″ 2′ 10″	21,600 00 6,075 00	15.9	74	14,996*	333	3,600	53,595	8 93
22	392 + 00 to 469 + 50 .	6,000 1,750	2′ 10″ 2′ 0″	24,300 00 7,087 50	11.4	148	28,560*	666	4,410	74,776	9 65
23	469 + 50 to 519 + 50 .	5,000	2′ 0″	1,575 00	11.1	37	9,929*	166	6,000	20,320	4 06
	Branch to Brookline, .	2,500	15″	-†	-	-	-	-	-	-	-
	Branch to Newton, .	1,584	18″	-†	-	-	-	-	-	-	-
	Including digging, .	3,168	24″	-†	-	-	-	-	-	33,359	4 60
	Totals, . . .	-	-	$220,792 00	-	-	$176,370	$114,975	$31,450	$658,477	-

Total cost, $658,477 ; allowance for three overflows, plus 15 per cent., $17,250, = $675,727.

* At $0.70 per cubic yard.

† At $4.60 per linear foot, including right of way.

To provide for the drainage of Milton, chapter 406, Acts of 1895, specifies that your Board may acquire so much of the Dorchester intercepter as extends from Central Avenue to Granite bridge. This includes sections 9, 10 and 11, already built, and is estimated to cost as follows: —

Section 9,	$45,573 06
Section 10,	43,692 62
Section 11,	17,000 00
Total,	$106,265 68

Neponset Valley Intercepting Sewer.

Estimated cost by city engineer of Boston (see City Document 195, page 8, 1894), exclusive of Germantown branch,	$388,201
Ten per cent. for engineering and contingencies,	38,820
Land damages,	32,000
	$459,021
Estimated cost by our study,	675,726
Excess,	$216,705

The excess of cost is accounted for in the following items: —

Extra masonry for large sewers,	$49,776
Two overflows,	10,000
Brookline and Newton branches, for which no provision was made by city engineer,	29,008
Difference between ten per cent. on $388,201 and fifteen per cent. on $587,588,	49,319
The city engineer allows for land taking ten feet in width; we have assumed that a width of twenty feet will be needed, thus increasing the legitimate land damage $32,000, and this we have taken in deeper excavation in the streets,	32,000
For lowering the grade two feet from Central Avenue to near Dedham and Hyde Park lines, required to properly provide for low areas in Milton and Hyde Park, near Clarendon Hills and Readville, a distance of 26,200 linear feet, involving extra cost for deeper excavation in earth and rock,	46,602
	$216,705

The act authorizes the expenditure of $500,000. If the above sections are paid for from this amount, the balance of $393,734.34 will provide for construction from Central Avenue to Mill Lane, Dedham.

If the whole $500,000 is used for construction, it will provide for construction to eight hundred feet beyond the New York, New Haven & Hartford Railroad (Dedham branch).

Respectfully submitted, WM. M. BROWN, JR.,
Chief Engineer.

As yet this Board has had no report from the State Board of Health. Expenditures to date amount to $2,649.95, particulars of which will be found in the Appendix.

GENERAL — ALL SYSTEMS.

At its meeting on Oct. 20, 1894, the following petition was signed by the full Board and ordered filed: —

COMMONWEALTH OF MASSACHUSETTS.

To the Honorable the Justices of the Supreme Judicial Court sitting in Equity.

Respectfully represent Hosea Kingman of Bridgewater in the county of Plymouth, Tilly Haynes of Boston in the county of Suffolk and Harvey N. Collison of said Boston, all in the Commonwealth of Massachusetts, that they are the Board of Metropolitan Sewerage Commissioners established under an act of the General Court of said Commonwealth, entitled "An act to provide for the building, maintenance and operation of a system of sewage disposal for the Mystic and Charles River valleys," being chapter 439 of the Acts of the year 1889; that sections 13 and 14 of said act are as follows: —

SECT. 13. The supreme judicial court sitting in equity shall, on the application of said board after notice to each of the cities and towns hereinbefore named, appoint three commissioners, who shall not be residents of any of the cities or towns mentioned in this act, who shall after due notice and hearing and in such manner as they shall deem just and equitable determine for each system the proportion in which each of the cities and towns hereinbefore named shall annually pay money into the treasury of the Commonwealth for the term of five years next following the year of the first issue of said scrip or certificates, to meet the interest and sinking fund requirements for each of said years as estimated by said treasurer, and to meet the cost of maintenance and operation of said system for each of said years, as estimated by the said board and certified to said treasurer, and any deficiency in the amount previously paid in, as found by said treasurer, and shall return their award into said court; and when said award shall have been accepted by said court the same shall be a final and conclusive adjudication of all matters herein referred to said commissioners and shall be binding on all parties.

Sect. 14. Before the expiration of said term of five years and every five years thereafter other commissioners, who shall not be residents of any of the cities and towns mentioned in this act, shall be appointed as aforesaid, who shall in such manner as they deem just and equitable determine the proportion in which each of said cities and towns in each of said systems shall annually pay money into the treasury of the Commonwealth as aforesaid for the next succeeding term of five years, and shall return their award into said court; and when said award shall have been accepted by said court the same shall be a final and conclusive adjudication of all matters herein referred to said commissioners and shall be binding on all parties.

That the scrip or certificates of debt to be issued in the name and behalf of the Commonwealth under the provisions of section 12 of said act were first issued in the year 1890, and thereupon a sinking fund was established; and thereafter, under the provisions of said section 13, this Honorable Court appointed as commissioners Hon. Ebenezer R. Hoar of Concord, Hon. William C. Endicott of Salem and Hon. John E. Sanford of Taunton, who duly made and returned their award into this court on the twelfth day of November, 1891, and the same was thereafter approved and ratified by this Honorable Court; that the estimate of the interest and sinking fund requirements to be made by the treasurer and the estimate of the cost of maintenance and operation to be made by your petitioners have been duly prepared, and that all other things required by said act to be precedent to the appointment of the commissioners for the second term have been done.

Wherefore, your petitioners pray that this Honorable Court appoint three other commissioners, who shall not be residents of any of the cities or towns mentioned in said act, to determine the aforesaid proportion and to perform the duties required by said act; and that such notice of this application as to this Honorable Court may seem proper may issue to each of said cities and towns, viz., Boston, Cambridge, Somerville, Malden, Chelsea, Woburn, Stoneham, Melrose, Winchester, Arlington, Belmont, Medford, Everett, Winthrop, Waltham, Newton, Watertown and Brookline, to appear and show cause, if any they have, why this application should not be granted.

(Signed) Hosea Kingman,
Tilly Haynes,
Harvey N. Collison,
Metropolitan Sewerage Commissioners.

This was filed with the clerk of the supreme judicial court Oct. 23, 1894, and on Jan. 7, 1895, a motion was made to amend the petition, as follows: —

SUPREME JUDICIAL COURT.

SUFFOLK, ss. IN EQUITY.

HOSEA KINGMAN *et al.*, *Petitioners.*

Motion to Amend Petition.

And now come the petitioners and move to amend their petition in the above-entitled proceeding, by adding thereto, before the prayer thereof, the following paragraph: —

And your petitioners further represent that by chapter 307 of the Acts of the year 1894 the issue of a further amount of scrip or certificates of debt, not exceeding five hundred thousand dollars, was authorized, to be considered as an addition to and a part of the loan above mentioned; the manner of increasing the sinking fund was prescribed, and the proportion in which each of said cities and towns should contribute in the years 1894 and 1895 was fixed; and it was further provided that said court, upon the application of your petitioners made in the year 1895, after notice as aforesaid, should appoint three commissioners, not residents of any of said cities or towns, for the purpose of determining the proportion in which each of said cities and towns should contribute as aforesaid for the term of five years next following the year 1895, and should return their award to be accepted by this court.

And your petitioners further move to amend said petition by striking out the word "other" before the word "commissioners" in the second line of the prayer of said petition, and by substituting the word "acts" for the word "act" wherever it occurs in said prayer.

By their attorney, WM. D. TURNER.

The court, on February 5, after hearing the parties interested, entered the following decree: —

COMMONWEALTH OF MASSACHUSETTS.

SUFFOLK, ss. SUPREME JUDICIAL COURT, IN EQUITY.

HOSEA KINGMAN *et al.*, METROPOLITAN SEWERAGE COMMISSIONERS, *Petitioners.*

And now, upon the above-entitled petition, it is ordered that William C. Endicott of Salem, John E. Sanford of Taunton and Edmund H. Bennett of said Taunton be and they hereby are appointed commissioners under section 14 of chapter 439 of the Acts of the year 1889, to determine the proportions in which the several cities and towns named in said act shall annually pay money into the treasury of the Commonwealth for the next succeeding term of five years, for the purposes therein set forth, and to perform all other duties and to exercise all powers imposed or conferred upon the three commissioners whose appointment is provided for in and by said section 14 of said act.

By the court, JOHN NOBLE,
Clerk.

FEB. 5, 1895.

Here the matter has rested to this time; but the Hon. Wm. C. Endicott, one of the commissioners appointed, having declined said appointment, the court will be asked at an early date to appoint a successor.

During the summer of 1894 the Boston Transit Commission, with the full knowledge and consent of this Board, appointed Mr. Howard A. Carson chief engineer of that Board, satisfactory arrangements having been made between the two boards, by which Mr. Carson should give to this Board such portion of his services as chief engineer as the condition of the work then being carried out might require, it being understood that the services required by this Board from Mr. Carson would become less each month, and at the end of six months from the time of his appointment as chief engineer of the Boston Transit Commission his entire services would be given to that Board. In accordance with said agreement, the Board, on Nov. 24, 1894, passed the following vote: —

Voted, That the salary of Howard A. Carson, the chief engineer of this Board, be fixed at the following amounts for the months of December, 1894, January and February, 1895: December, 1894, $260; January, 1895, $160; February, 1895, $105.

The auditor of the Commonwealth was duly notified by the clerk of this change.

In accordance with the terms of the above agreement, the time having arrived when the Board would be deprived of the services of its chief engineer, and in view of his anticipated absence abroad for several months, making investigations for the Boston Transit Commission, the Board, on Feb. 4, 1894, took under consideration the appointing of an engineer to take charge of the work during Mr. Carson's absence. Upon the recommendation of the chief engineer, it was

Voted, To authorize the chief engineer to communicate with Wm. M. Brown, Jr., regarding reappointment as assistant engineer of this Board, at his former salary, he to act as chief engineer in the absence of the latter.

In accordance with this vote, Mr. Carson sent Mr. Wm. M. Brown, Jr., the following communication: —

COMMONWEALTH OF MASSACHUSETTS,
METROPOLITAN SEWERAGE COMMISSION, CHIEF ENGINEER'S OFFICE,
110 BOYLSTON STREET, BOSTON, Feb. 20, 1895.

WM. M. BROWN, Jr., Esq., *68 Hawthorne Street, Chelsea, Mass.*

DEAR SIR: — In accordance with the vote of the Board, and in accordance with the request of its chairman, I hereby request and empower you to act as chief engineer of the Metropolitan Sewerage Commission during my absence.

Yours respectfully,
(Signed) H. A. CARSON,
Chief Engineer.

At its meeting on February 23 a copy of the above communication was presented to the Board by Mr. Carson, and the Board

Voted, To grant the chief engineer three months' leave of absence, beginning March 1, 1895, he to receive no compensation meantime.

This action was communicated to the auditor in the following note: —

COMMONWEALTH OF MASSACHUSETTS,
METROPOLITAN SEWERAGE COMMISSION, 110 BOYLSTON STREET,
BOSTON, Feb. 23, 1895.

HON. JOHN W. KIMBALL, *State Auditor, State House, Boston, Mass.*

DEAR SIR: — At its meeting this morning this Board voted to allow its chief engineer, Mr. Howard A. Carson, a three-months leave of absence, beginning March 1, 1895, without salary.

For the Board, yours very truly,
(Signed) EDWARD P. FISK,
Clerk.

Mr. Carson left Boston for a trip abroad about the first of March (Mr. Wm. M. Brown, Jr., filling the post as acting chief engineer), and upon his return in May he sent the following communication to the Board, which was presented at its meeting on June 8: —

Boston, May 27, 1895.

Hosea Kingman, Tilly Haynes, Albert F. Noyes,
Metropolitan Sewerage Commissioners.

Gentlemen: — The metropolitan sewerage system is now very nearly completed. In view of this fact and of my duties elsewhere, I ask you to accept my resignation as chief engineer. I do not need to say that my deep interest in the work and in all connected with it will continue. Thanking you for your constant courtesy and consideration,

I remain yours truly,
(Signed) H. A. Carson.

Thereupon the following was unanimously passed by this Board: —

Resolved, That we recall with pleasure the years of honest, faithful and efficient service rendered the Commonwealth by our chief engineer, Howard A. Carson, in bringing to substantial completion the metropolitan sewer system; that we regret the necessity which has compelled him to place in our hands his resignation, but feel constrained to accept it, believing that in his new position as chief engineer of the Rapid Transit Commission he can be of greater service to the Commonwealth.

Voted, That his resignation be accepted as of June 1, 1895.

Voted, That we cheerfully recommend him as an engineer fully competent to successfully carry out any work which he may be willing to undertake.

Voted, That the foregoing resolve be spread upon the record, and that a copy of the same with a copy of these votes be transmitted to Mr. Carson.

The foregoing resolution and votes, with the accompanying letter, were forwarded to Mr. Carson: —

COMMONWEALTH OF MASSACHUSETTS,
METROPOLITAN SEWERAGE COMMISSION, 110 BOYLSTON STREET,
BOSTON, July 2, 1895.

Mr. HOWARD A. CARSON, *60 State Street, Boston.*

MY DEAR SIR: — I have the honor of transmitting herewith an attested copy of the resolves and votes passed by this Board upon the receipt of your resignation as chief engineer.

It is hardly necessary for me to add that all who were associated with you upon the work heartily join in regretting the necessity that has compelled the resignation, and sincerely trust that equal success may attend your efforts in any field of work you enter.

With kindest wishes, believe me,

Very cordially yours,

(Signed) EDWARD P. FISK.

At its meeting on June 15 the Board chose Wm. M. Brown, Jr., to be superintendent of the north metropolitan and Charles River valley systems of sewerage, and also chief engineer for the construction of the Neponset River valley system, at an annual salary of $3,700, said appointment to date from July 1, 1895.

The lease of the rooms in the Walker building, 110 Boylston Street, Boston, expired on the fifteenth day of March, 1895, and were renewed by this Board for a term of one year, at the same rate, — $3,050, with the proviso that the Commonwealth shall have the right to deliver up two of the smaller rooms, or either of them, at the end of any month, by giving written notice of its intention to do so two months prior thereto; and upon such delivery the rent shall be reduced at the rate of $300 per annum for each room so delivered. On March 30, 1895, a communication was received from the acting chief engineer of the Boston Transit Commission, asking if some temporary arrangement could not be made for conducting tests of cement for said commission in the quarters of this Board, and by the person in charge of said department. They were informed that said experiments could be conducted upon the premises of this Board and with its tools and appliances so long as one-half of the time of Nelson A.

Hallett, in charge of such tests, would suffice; the Transit Commission to pay one-half the salary of said Hallett, one-half the rent of the room used for making such tests and also pay cost of all new apparatus required. A communication from the acting chief engineer of the Transit Commission notified this Board of the acceptance of said proposition by the commission, said agreement to take effect on April 1, 1895.

The American Society of Civil Engineers in June last held its annual convention in Boston and vicinity, and on May 25 this Board

Voted, To extend to the members of said convention the courtesies of this department, and to afford them every facility for inspection and obtaining information desired.

The members of said convention were afforded in accordance with the above vote every facility for inspecting the pumping stations and other works connected with this system, and on the day of their harbor excursion visited in a body the pumping station at Deer Island to witness the pumps in operation.

Albert F. Noyes of Newton was appointed by the governor, and confirmed by the council, as a member of this Board for three years from the first Monday in January (Jan. 7, 1895), to be the successor of Harvey N. Collison of Boston, whose term then expired.

The annual meeting of the Board was held, as provided by the act, on the first Monday of February (Feb. 4, 1895), and Hosea Kingman of Bridgewater was chosen chairman, and Edward P. Fisk of Boston clerk, for the year.

The increasing demand for copies of the annual report of this Board (Public Document No. 45) has rendered the edition authorized by chapter 292, Acts of 1891 (fifteen hundred copies), wholly inadequate to meet such demand, and last year an extra edition of the seventh annual report was printed by authority of chapter 64, Resolves of 1895. A similar edition will be needed the present year, and in view of these facts we would respectfully recommend that the regular edition be increased to three thousand copies, one-half of which shall be bound in cloth, one-half of the edition to be distributed under the direction of this Board.

The Appendix contains tables showing in detail the receipts and expenditures for the year, also the assets and liabilities at date.

HOSEA KINGMAN,
TILLY HAYNES,
ALBERT F. NOYES,
Metropolitan Sewerage Commissioners.

Boston, Oct. 1, 1895.

REPORT OF CHIEF ENGINEER

AND

SUPERINTENDENT.

REPORT OF CHIEF ENGINEER

AND

SUPERINTENDENT.

Boston, Sept. 30, 1895.

Hosea Kingman, Tilly Haynes, Albert F. Noyes,
Metropolitan Sewerage Commissioners.

Gentlemen : — During the year ending Sept. 30, 1895, the construction hereinafter described was carried on under the direction of Howard A. Carson, Chief Engineer, until Feb. 20, 1895. During the months of March, April and May Mr. Carson was granted leave of absence, and on his return, June 1, 1895, owing to the fact that the Metropolitan Sewerage System was practically completed, and in view of his duties elsewhere, he tendered his resignation. From February 20 to June 1 the writer has served as Acting Chief Engineer, and since the latter date as Chief Engineer and Superintendent. So much of the following report as relates to construction prior to June 1 has been examined and approved by Mr. Carson.

The North Metropolitan System has been substantially completed during the year. The main sewer and all the branch lines are built, except five hundred feet of small sewer (part of Section 35) on Mystic Avenue, in Somerville, near the Medford line. The pumps at the two large pumping stations, Deer Island and East Boston, have been in operation about four months. The Charlestown station on the Cambridge branch was opened for service September 23, and the city of Cambridge is already delivering part of its sewage to it. On the Alewife Brook branch a temporary pumping plant was installed June 1, and will be operated during the construction of the permanent house and the installment of the permanent pumps, which will be not later than December 1. Sewage is now being delivered at the Deer Island outfall from the following localities: Winthrop, Everett, Malden, Melrose, Medford, Winchester, Woburn, Belmont and Cambridge.

A detailed statement relating to construction during the year follows : —

SECTION 1 (DAY WORK), OUTLET DEER ISLAND.

Location. — Westerly side of Deer Island spit, as far as abreast of Deer Island light.

Progress during the year, ...	357 linear feet.

Assistants.

Assistant Engineer: Frederick D. Smith.
Foreman of Construction of Pipes: John Craib.
Foreman of Dredging, preparing Trench and laying Pipes: Chris Rasmussen.
Diving by Hiram W. Phillips and George L. Phillips.
Dredging: Excavation by Eastern Dredging Company.
" Back-filling by Bay State Dredging Company.
Pile-driving by Josiah Shaw.
Draughtsman: William J. Watkins.
Transitman: J. T. P. Jones.
Supply Clerk: Francis J. Doherty.
Time-keeper: William C. Ham.

Character of Structure. — The structure consists of masonry pipes, encased in wooden lagging, similar to those described in the sixth annual report. The same method has been used in the preparation of the trench and in the laying of the pipes as described in the above-mentioned report. The last pipe was of special design. It consisted of a straight pipe for 39 feet, and at the end of this a quarter-turn enclosed in a rectangular caisson 13 feet long, 11 feet wide and 11 feet high. This was built of 6-inch spruce, and holds enough masonry (brick and concrete) to make a secure anchor for the end of the sewer. The caisson was securely fastened to the straight part of the pipe by overlapping and by a 5 by 5 by ½ inch angle hoop. It was necessary to leave out a large portion of the masonry in order to allow the pipe to float. After the pipe had been laid the masonry was completed from the inside. (For details of this pipe, see cut in sixth annual report.)

End of Outfall. — The outlet is at the original surface of the spit (grade 99.6). Around the opening a rectangular floor, about 35 by 35 feet, has been paved with granite, 12 inches thick, in blocks of 1,000 to 2,000 pounds each. This is protected by a row of piles extending the whole distance on the westerly side and about half the distance on the southerly side. Its purpose is to prevent washing by the discharge of sewage at low tide; also from the action of the sea.

Man-hole at Station 12. — At Station 12+00 (lowest part of sewer) a special pipe was made, having a vertical branch. This branch was carried up to grade 98 when the pipe was built. It has since been carried up to grade 102 by a special casting. This casting is bolted to the pipe, and surrounded on the outside by a concrete wall 3 feet in thickness, and the brickwork of the sewer is carried up inside to within 6 inches of the top. This makes a man-hole having a diameter of 24 inches at the top and 33 inches at the bottom, with a wooden bulkhead at the roof of the sewer, which is suspended by 4 wooden rods 2^1 inches in diameter. These rods are fastened to cross-pieces resting on the top of the brickwork in the man-hole. This man-hole is completely filled with sand, to prevent any air collection. After the sand had been put in, the 6-inch space above the brickwork, inside the man-hole, was completely filled with asphalt concrete. The cover was then put in place and fastened by toggle-bolts; then the whole was encased by a covering of asphalt concrete. This man-hole was provided as a means of pumping out the sewer in case of needed repairs.

Difficulties. — The frequency of storms (during October and November, 1894) made it difficult to keep a tidal fence standing, consequently the pipes had to be handled when exposed to nearly the full force of the tide. Sometimes this was difficult, and in some instances the connection between the pipe being laid and the one previously laid had to be deferred to low water. Pipes were laid on the following dates: October 4, 7, 13; November 2, 12, 14, 19; December 4.

The violent storm of Oct. 22–25, 1894, did considerable damage to the work. The heavy sea broke away two of the pipes (which had been laid and partly back-filled) from the preceding pipe, and tossed them about, doing considerable damage to the false-work. It was found necessary to take one of these back to the wharf for safety. On November 4 this pipe was taken back to its position at the outfall, when another storm arose which lasted three days. The pipe was tossed about by the sea as before, again damaging the false-work, also receiving some damage itself. It was then towed back to the wharf and repaired. The breaking apart of these pipes delayed the work about three weeks, and was caused by the neglect of the dredging company to properly attend to the back-filling.

Miscellaneous. — The completion of the masonry in the interior of the pipes was carried on continuously until finished on Jan. 16, 1895.

On May 8, 1895, the outermost bulkhead of Section 1 was removed and the sewer flooded as far as the check-valves at the pumping station. On May 9, 1895, pumps first discharged through outfall, the material pumped being salt water and leakage of the sewer.

Cost. — The total cost of Section 1 from beginning (June 1, 1893) is as follows: —

Coffer-dam process,	$60,500 00
Sewer built in sections and floated to position,	77,588 70
Total cost,	$138,088 70
Average cost per linear foot, coffer-dam process,	$89 76
Average cost per linear foot, sewer built in sections and floated to position,	61 73

Accident. — At 6.30 A.M., on Dec. 27, 1894, during a violent storm, D. S. Bliss, night watchman at the point, was blown over. His foot caught in the trestle-work, and he remained suspended by a broken leg for an hour and a half.

PUMPING STATION AND CONNECTIONS, DEER ISLAND.

Location. — On the south-westerly side and about midway of Deer Island.

Day Work.

State Assistants.

Assistant Engineer to Dec. 4, 1894: Frank E. Winsor.
Assistant Engineer since Dec. 4, 1894: Frederick D. Smith
Foremen: John Craib, Chris Rasmussen.
Transitman: J. T. P. Jones.

All masonry in foundations, inlet sewer and discharge sewer, was completed previous to this year.

Following is a statement of miscellaneous work during the past year, with cost: —

Constructing salt-water well with connections,		$1,419 98
Laying 6-inch water pipe from receiving house to pumping station,		2,304 18
Miscellaneous work on screen-chamber and screen-machinery,		531 73
Work inside station: —		
Heating and ventilating apparatus,	$538 00	
Sub-floor of concrete in engine-room,	351 00	
Weir for testing pumps,	579 89	
		1,468 89
Putting in drains around station,		995 07
Grading about station, excavating hill back of station and laying down to grass,		2,900 00
Retaining-wall back of station,		1,558 65
Riprap in front of station and foundation for sea wall,		1,750 50
Removing temporary buildings,		75 00
Putting in sub-foundations for coal-pocket and screen-house,		374 60
Preliminary testing of pumps,		1,350 00
Miscellaneous items,		*6,944 40
		$21,673 00

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* This $6,944.40 includes some bills properly belonging to last year, rental of engines, superintendence, pumping for five months, heating building last winter, concreting around check-valves, expressage, watchman, telephone, carriage to Winthrop, ferryman, transporting material from Shirley Gut to pumping station, repairing slope back of station several times, stopping leaks, cement-washing, building collar and cutting masonry for bulkhead in discharge sewer, putting in pipes for floats, making stop-planks, building foundations for feed-pumps and economizer engine, putting covering stones over trench in boiler-house, etc.

Accident. — On May 31, 1895, a small portion of the bank back of the coal-pocket caved during excavation, instantly killing Stephen Healey and slightly injuring Patrick Myers, James Crowley and Michael Brien.

Contract Work completed.

Engine- and Boiler-house. — The engine- and boiler-house described in last year's report was completed (except some minor details) about Nov. 15, 1894.

Pumping Plant. — Previous to Sept. 30, 1894, the pumps had been placed and some of the heavier portions of the engines were in position. During the past year the boilers and fuel economizer have been put in and the engines piped and completed. The boilers were completed Feb. 1, 1895; engine No. 1 was first started March 5, 1895; first water pumped over weir March 8, 1895; engine No. 2 started about March 15, 1895.

Between April 1 and April 28, 1895, unofficial capacity tests were made on the pumps. It was found that each could probably safely deliver 70 cubic feet per second to a height of 19 feet, as called for by the contract. The pumps were put into daily service June 1, 1895.

Miscellaneous. — Miscellaneous small contracts for different items of work have been awarded during the year as follows: —

Screens, James Flynn,	$325 00	
Screen-machinery, J. H. Long,	666 00	
Iron work for supporting screen-machinery, L. M. Ham & Co.,	496 00	
Engines for raising screens, Rice Engine and Boiler Company,	248 00	
		$1,735 00
Plastering interior of station, J. J. Ford & Co.,		275 00
Iron flooring over trenches in engine-room, Chelmsford Foundry Company,		556 70
Interior finish in station, William Richmond & Co.,		2,110 00
Marble floor in engine-room, Phillip H. Butler & Co.,		567 00
Removing old hospital building, John Soley,		225 00
		$5,468 70

Contract Work in Progress.

Coal-pocket and Screen-house.

Architect: Arthur F. Gray.
Inspector: Caleb Kimball.
Contractors: Mack & Moore of Boston.
Contractors' Foreman: Luther Sykes.

A brick coal-pocket 74 feet long by 34 feet wide, with a dynamo-room attached, has been partly built, adjoining the boiler-house on the north end. This building is to be of one story with slate roof, similar to engine- and boiler-house, and will have a capacity of 600 tons. There will be a coal-run erected from the outer end of the wharf to the coal-pocket, a distance of about 500 feet.

A brick screen-house 27 feet long by 23 feet wide is being built adjoining coal-pocket on west side. This building is to have a slate roof and will be of two stories. The first story will be occupied by the screen-machinery; the second will be used as a storage room.

Work was begun on coal-pocket and screen-house July 1, 1895. At present (Sept. 30, 1895) coal-pocket walls are completed, and three roof trusses are in place. The walls of the screen-house are about 14 feet high. The coal-run is partially completed.

Dwelling-house.

Location. — About 150 feet south of the pumping station.
Architect: Ernest N. Boyden.
Inspector: Caleb Kimball.
Contractors: Hersee Brothers of Roslindale, Mass.

This is a two-story, four-tenement dwelling, to be occupied by the permanent employees of the pumping station. The main portion is 71 by 30 feet, with two wings, 18 by 17 feet, on the rear. At present (Sept. 30, 1895) the cellar is completed, the sills in place and the first floor nearly laid. Work was commenced on this dwelling Aug. 30, 1895. The contract price was $9,995.

SECTION 3½ (DAY WORK), SIPHON, SHIRLEY GUT.

During the year the stone masonry of the head-houses at the extremities of the siphon has been completed, and the temporary steel extension of the siphon man-hole on the Winthrop end has been removed. The opening at this man-hole has been closed by a granite block. The sheeting on the Winthrop shore has been cut away and the surface brought to its original condition. The openings in each head-house have been floored by a built-up cover of boiler plates and angle irons. All temporary buildings have been removed. The cost of the work during the year has been $864.63.

SECTION 7 (DAY WORK), WINTHROP AND EAST BOSTON.

Location. — From a point about 300 feet westerly from Pleasant-street station, on the Boston, Winthrop & Shore Railroad, across Belle Isle Inlet and Marsh Island to a point on the marsh in East Boston about 100 feet westerly from Riverside Avenue.

Assistants.

Assistant Engineer to Dec. 29, 1894: Henry H. Marden, Jr.
Assistant Engineer since Dec. 29, 1894: Frank I. Capen.
Superintendent of Construction: Charles G. Craib.
Superintendent for Repairs of Siphon: Charles A. Haskin.
Engineering Clerk to Dec. 1, 1894: R. H. Sumner.

The work during the year comprised making a twenty-five foot closure in siphon; building gate-chamber and connections with siphon and sewer at east end of siphon; repairing break in sewer (mentioned in last report); cleaning and tightening that part of the siphon which was built by the contractors; cleaning, pointing, scraping and cement-washing that part of the section completed by the contractors prior to July 21, 1894.

As stated in the sixth annual report, grout was poured around the wooden forms which had been put in place to make the twenty-five foot closure. After this grout had been allowed to remain undisturbed for eight days, the trench was pumped out. It was found that the grout had filled the trench about 20 inches higher than intended, and that it had set hard. In several places, however, water boiled through the grout in the bottom of the trench. The work of cutting out the excess of grout began at once, the trench being pumped out at about half tide, and the work being carried on during the lower half of the tide. At high tide the trench was allowed to flood, an opening in the coffer-dam being made for that purpose. When all but a few inches had been cut out in this manner, pumping was stopped and the remaining cutting and shaping done by divers. After this was finished, the ends of the masonry were joined by wooden cylinders, which were lowered through the water in the trench and secured in position by divers. All joints, where cylinders butted against masonry or against each other, were carefully covered with canvas, and then grout of neat Portland cement was poured around them, filling the trench to about 10 inches above the springing line. After the grout had ample time to set, the trench was pumped out and concrete masonry put in to the finished cross-section of the siphon. The wooden cylinders connecting the two ends of the siphon were 5 feet inside diameter and made of cypress staves

$1\frac{1}{4}$ inches thick, bound by elm hoops $\frac{1}{4}$ inch by $1\frac{1}{2}$ inches, placed close together. All the wood was thoroughly coated with wax tailings, and a coating of pure asphalt $\frac{1}{4}$ inch thick was applied to the outside of the finished cylinder. The work of making this closure was finished Dec. 14, 1894.

About the middle of September work was commenced on building the east gate-chamber, and progressed without difficulty until finished in December, 1894.

During the month of September, 1894, many attempts were made to pump out that part of the siphon which had been built by the contractors, but with no success. It was finally determined to install an air plant, and do what work was required at this point with the aid of compressed air.

About November 1 an effort was made to force the water out by the compressed air on the middle tube of the siphon. When the air was first applied it was found that the water could be forced only part way down the goose-neck, the air escaping so rapidly that it was impossible to maintain pressure sufficient to get down to the siphon.

On the 3 tubes the forms used in construction had been left in the goose-necks. A portion of them had been removed from the lower part of the siphon. These forms were taken out of the goose-necks and the work pointed with neat Portland cement. This made it tight so that the water was forced down level with the roof of the siphon. It could be forced no lower, however, as the air blew out for the entire length of the tubes. When this point was reached the tube was filled with horse manure, which was forced by the pressure of the air against the body of water, holding it back. This manure was then gradually forced forward by rammers, and, as soon as a leak was discovered in the masonry, which for the most part was strong but porous, the imperfect masonry was cut out, the hole thoroughly washed, and then pointed with neat Portland cement. In this manner it was possible to force the way for the entire length of the tube. The ribs used in construction made it difficult in many places to force the horse manure forward. It took about three weeks to point and clean this tube. After the middle tube was cleaned, a hole was cut through the masonry, near the air lock, to each of the side tubes in succession, and these treated in a similar manner.

About November 26 the work of lining the tubes with Portland cement plaster was commenced. Elm barrel hoops, placed 5 to the foot, riveted with copper rivets, were embedded in Dyckerhoff cement plaster (mixed 3 parts sand to 1 part cement) $1\frac{1}{2}$ inches thick. This work of lining followed the pointing and cleaning from tube to tube. By the time the portion of the 3 tubes west of the closure had been treated in the above manner, the closure in the siphon had been completed, and bulkheads built in each tube at the chamber on the easterly side of the inlet.

The bulkheads midway were then removed, and the remaining portion of the siphon treated in a similar manner, but it was not found necessary to use the horse-manure bulkhead.

After the tubes had been pointed and lined, the maximum leakage in any one of the tubes did not amount to more than 150 gallons per day. The northerly tube, at the date of this report (Sept. 30, 1895), after standing about eight months, is less than half filled.

The work of cleaning and pointing was finished about Feb. 1, 1895. The lining was finished Feb. 11, 1895, the air pressure being taken off on that date.

Besides the work inside the siphon, there was considerable miscellaneous work being done at Section 7 during the winter. On the Winthrop side of the inlet clay filling was placed on both sides of the coffer-dam, as high as the top of the sewer; also over the top of the sewer near the head-house.

Other miscellaneous work has been done as follows: The inside of the sewer and siphon for the whole length of the section was cement-washed. Stop-plank grooves were built at the chamber on each side of the inlet. Iron steps were put in each of these chambers. A temporary wooden invert was built in the sand-catcher, reducing the area of the channel. Heavy wooden ribs were set, 4 feet apart on centres, anchored firmly to the masonry, and a floor of 4-inch plank laid on these. The space below the floor was filled with sand.

Removing Obstructions in Tidal Channel. — On March 16 a contract was awarded, for removing obstructions in the tidal channel, to Charles G. Craib, for $2,400. He commenced work on March 25; finished May 11.

Overflow and Grading. — This overflow consists of a brick-lined masonry structure with a cut-stone outlet, the whole resting on piles, extending from the opening in the masonry, on the southerly side of the sand-catcher, to low-water mark, a distance of about 75 feet.

On the Winthrop side filling has been deposited on both sides of the coffer-dam, and over the top of the sewer from high-water mark to and around the head-houses, and the slopes paved with hand-laid riprap. On the East Boston side filling is being deposited around the coffer-dam and over the structures, and the slopes on the harbor side are being paved with hand-laid riprap.

The contract for doing the grading and laying the riprap was awarded to David Burnett; the riprap at $4 per cubic yard, laid 1 foot thick on a base of chip stone not less than 8 inches in thickness; the filling at 53 cents per cubic yard in place.

The work on the overflow was started in the middle of July; the grading about August 1.

The above work is still in progress.

Assistants on Overflow and Grading.

Foreman on Overflow and Inspector of Grading: Patrick McCarthy.
Transitman: William M. Stodder.
Assistant: Mark E. Taylor.

Cost of Work at Section 7 from July 21, 1894, to Sept. 30, 1895.

Tightening and filling existing coffer-dam,		$1,445 51
Making closure in siphon:—		
(*a*) Excavating and preparing trench for tubes,	$4,886 02	
(*b*) Making and setting tubes,	1,831 98	
(*c*) Grout and concrete masonry,	3,768 42	
		10,486 42
Cleaning and tightening finished siphon,		8,563 96
Lining siphon and goose-necks,		4,230 00
East gate-chamber and connections with siphon and sewer,		4,830 90
Miscellaneous work, including cement-washing and cleaning whole section except siphon, laying coping to west gate-chamber, building stop-plank grooves at head-houses and building false invert in sand-catcher, etc.,		5,128 89
Removing coffer-dam (contract of Charles G. Craib),		2,400 00
Grading before July 6,		1,044 75
Overflow and grading since July 6,		6,262 00
		$44,392 43

PUMPING STATION, EAST BOSTON.

Location.—On the northerly side of Addison Street, about 300 feet from the corner of Chelsea and Addison streets, on south side of Chelsea Creek, east of and adjacent to Grand Junction Railroad location.

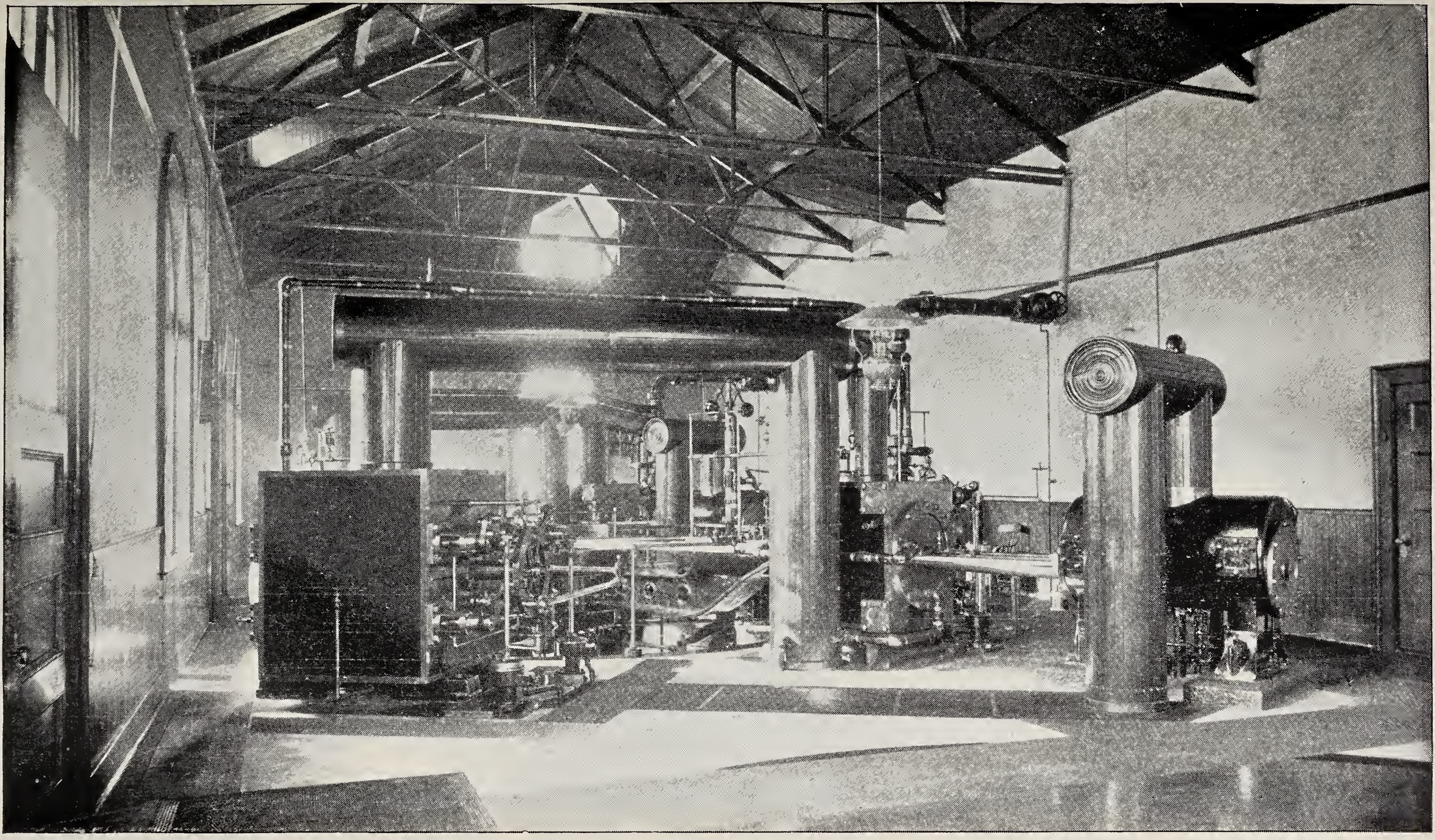
Day Work.

Assistants.

Assistant Engineer to April 17, 1895: Henry H. Marden, Jr.
Assistant Engineer since April 17, 1895: Frank I. Capen.
Transitmen: Principals—Charles Kincaid, George E. Howe.
Assistants—J. J. Comfrey, Osgood F. Barnes, Wm. M. Stodder.

The principal features of the work were described in the last report.

Wharf.—The wharf is located on the shore of Chelsea Creek, east of the boiler-house. It is 73 feet long by 42 feet wide, built



ENGINE ROOM, EAST BOSTON PUMPING STATION.

of hemlock piles, spaced 6 feet on centres, capped by 10 by 12 inch hard pine sticks. The floor timbers are 4 by 8 inch and 4 by 10 inch spruce, boxed to a uniform height of 7 inches above the caps. The flooring is of 4-inch spruce. Where the wharf joins the shore, a dry retaining-wall was built. The piles, labor and tools for building the wharf were furnished by Augustus Belliveu & Co.

The creek bottom, in front of the wharf, to the channel was dredged, so as to give a depth of 3 feet at mean low water, the work being done by the Eastern Dredging Company.

Salt-water Supply for Condensers. — This consists of an iron tank, 9 feet in diameter, lined with 12 inches of masonry, located under the wharf sufficiently low to obtain a supply of water at the lowest tide. A pipe communicates with the tide water, and a 10-inch pipe leads from the tank to the condenser. Copper screens of ¼-inch mesh are placed in the tank, between the inlet and outlet pipes.

Following is a statement of miscellaneous work done during the past year, with cost: —

Wharf, etc. (as described above),		$2,036 84
Salt-water supply for condensers (as described above),		928 95
Miscellaneous work on screen-chamber and screen-machinery,		484 73
Work inside station: —		
Heating and ventilating apparatus,	$520 74	
Sub-floor of concrete in engine-room,	300 00	
Weir for testing pumps,	542 11	
		1,362 85
Miscellaneous items,		*4,100 00
		$8,913 37

Sidewalk and Grading. — A contract has been made for setting edgestones and paving sidewalk in front of the station. This work is now in progress. The grading about the grounds is also in progress, and will soon be finished.

Contract Work.

State Assistants.

Architect: Arthur F. Gray.
Assistant Engineer to April 17, 1895: Henry H. Marden, Jr.
Assistant Engineer since April 17, 1895: Frank I. Capen.
Transitmen: Principals — Charles Kincaid, George E. Howe.
Assistants — J. J. Comfrey, Osgood F. Barnes, William M. Stodder.

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* This includes numerous small items incidental to the various contracts, preliminary testing of pumps, cutting out and building masonry in conjunction with piping about the station, building feed-pump foundations, cement-washing masonry of pump-wells, changes in economizer flues, providing for boiler blow-off and grading about grounds.

Engine- and Boiler-house. — The greater portion of the work to be done under this contract was completed prior to the last report. That remaining was finished by January, 1895. The amount of the architect's final estimate for this contract is $20,329.18.

Pumping Plant. — The boilers were completed Feb. 1, 1895; engine No. 1 was first started Feb. 13, 1895; water first pumped over weir Feb. 19, 1895.

From about the first to the middle of April unofficial capacity tests were made on the pumps. It was found that each could probably safely deliver 70 cubic feet per second, to a height of 19 feet, as called for by the contract. The pumps were put into daily service June 1.

Miscellaneous. — Miscellaneous small contracts, for different items of work, have been awarded during the year as follows: —

Screens, James Flynn,	$376 80	
Screen-machinery, J. H. Long,	590 00	
Iron work supporting screen-machinery, L. M. Ham & Co.,	527 72	
Engines for raising screens, Rice Engine and Boiler Company,	248 00	
		$1,742 52
Plastering interior of station, J. J. Ford & Co.,		235 00
Iron work over trenches in engine-room, Chelmsford Foundry Company,		547 70
Interior finish in station, William Richmond & Co.,		1,789 00
Marble floor in engine-room, Philip H. Butler & Co.,		510 00
		$4,824 22

Coal-pocket and Screen-house. — A coal-pocket 54 feet long by 32 feet 6 inches wide, with a capacity of 600 tons, has been built on the wharf, adjoining the boiler-house at the north end of the main building. This coal-pocket is of wood, covered with red slate to match that on the roof of the main building. The contract was awarded to William T. Eaton for $4,598. The work was commenced June 24 and finished about September 25.

A brick screen-house, 19 feet long by 18 feet wide, with a roof of red slate, has been built on the northerly end of the main building, opposite the engine-room. The contract was awarded to O'Connell & Furbish, for $2,100. Work was commenced July 1, and the building is now practically completed.

Sea Wall. — A contract for extending the sea wall back of the pumping station, as far as the boundary line between the pumping station lot and the property of the Boston & Albany Railroad, has been awarded to W. H. Wyman for $650, and work on this is now in progress.

SECTION 10 (DAY WORK), EAST BOSTON AND CHELSEA.

Location. — From pumping station at East Boston, near the Grand Junction Railroad bridge over Chelsea Creek, thence under Chelsea Creek, between the Grand Junction Railroad bridge and the Chelsea-street road bridge to a point on Marginal Street, near Eastern Avenue, in Chelsea, where connection is made with Section 12.

Assistants.

Assistant Engineer: Henry H. Marden, Jr.
Transitmen: Principal — Charles Kincaid.
Assistants — J. J. Comfrey, Osgood F. Barnes.
Foreman for Building Overflow and Temporary Invert of Sand-catcher: Michael Tallent.

During the year a temporary overflow has been constructed from the chamber at the end of the sand-catcher to low-water mark, and a temporary wooden invert, similar to the one described in the report for Section 7, has been constructed inside of the sand-catcher.

The overflow extends from the tide gate-chamber to permanent low-water mark. The temporary overflow is a wooden flume, open at the top, and floored with 4-inch plank. The sides are of 2-inch plank, driven vertically, and secured by rangers and braces. The tops of the planks are bound between two 4 by 6 inch spruce ribbons. At intervals of about 16 feet the two sides of the flume are connected by 1¼-inch round iron rods. The inside width of the overflow is 13 feet, to admit of a masonry structure being built inside at some future time. The approximate cost of this work was $1,300.

The temporary wooden invert has a width, at the springing line, of 15 feet 5 inches, and at the water line the width is 6 feet. Heavy ribs, spaced every 4 feet, were securely fastened to the masonry by wedge-bolts. These were covered with 4-inch spruce planks. The space between the planks and the masonry was filled with coarse bank gravel. The approximate cost of the work was $1,500.

The street and sidewalk, on the Chelsea side, were made satisfactory to the local authorities.

SECTION 11, CHELSEA.

Location. — From Marginal Street, Chelsea, through Eastern Avenue to near Willoughby Street, crossing under the Boston & Albany Railroad (Grand Junction) and Bass Creek.

Length of section,	3,037 feet.

Diameters of sewer, 2 feet 1 inch by 2 feet 10 inches.

Contractor. — Charles Linehan of Cambridge, Mass. Mr. Linehan has acted as his own superintendent.

State Assistants.

Assistant Engineer and Inspector: Francis L. Sellew.
Transitman: W. Gordon Crispin.

Trench.

Length completed,	3,037.00 feet.
Average depth of excavation to bottom of pile cap,	17.00 "
Greatest depth of excavation to bottom of brickwork,	18.35 "
Average width, top of trench,	6.00 "
Average width, bottom of trench,	4.20 "
Volume of excavation per linear foot,	3.25 cu. yds.

Approximate cost of trench per linear foot, including sheeting left in, excavation, back-filling, etc., $3.33.

Character of Excavation. — At lower end of section: 1 foot of gravel and ashes, 1 foot of filling (ashes, etc.), 2½ feet gravel and clay, 7½ feet of fibrous peat, with silty sand below. This formation extends for 1,018 feet, to near Cottage Street. For 200 feet northerly from Cottage Street: 1 foot of gravel and ashes, 2 feet of filling (ashes, etc.), underlaid by hard yellow clay to bottom of trench. Next 400 feet: 1½ feet of gravel and ashes, 10 feet of yellow hard-pan, blue hard-pan below. From Bass Creek to end of section, a distance of 1,419 feet: 1½ feet road surfacing (principally ashes), 2½ feet filling (gravel and clay), 6½ feet fibrous peat, and fine silty sand below. The silty sand mentioned in this paragraph was so fine that 81 per cent. passed through a sieve having 14,400 meshes to the square inch, and 20 per cent. through one having 32,400 meshes to the square inch.

Masonry.

Contract price: —

Brickwork, American cement mortar, per cubic yard,	$13 00
Brickwork, Portland cement mortar, per cubic yard,	16 00
Concrete, American cement mortar, per cubic yard,	4 50
Concrete, Portland cement mortar, per cubic yard,	6 00

Length completed,	3,034 feet.
Diameters of underdrain laid and length of each size: —	
6-inch,	335 "
8-inch,	294 "

Masonry was begun June 20, 1894; was finished Feb. 2, 1895.

Approximate cost of masonry per linear foot of trench, including piles, underdrain, etc., $5.58.

Approximate cost of section per linear foot of excavation and masonry, including labor, material, inspection, etc., $9.19.

NOTE. — The information regarding Section 11 following this note relates solely to the year ending Sept. 30, 1895. For a description of the work performed prior to this year, see the sixth annual report.

Excavation.

	Opening No. 2.	Opening No. 3.
Character of opening,	Open cut,	Open cut.
Date of starting,	May 30, 1894,	Aug. 29, 1894.
Point of beginning,	About 80 feet north of Boston & Albany Railroad.	Central Avenue.
Point of ending,	Near Willoughby Street, end of section.	Junction of Eastern Avenue and Marginal Street.
Finished or in progress September 30.	Finished Feb. 16, 1895,	Finished Oct. 25, 1894.
Length,	2,461 feet,	258 feet.
Ordinary progress per week.	67 feet,	32 feet.
Appliances used,	Trench machine and derrick.	Derrick.
Gang ordinarily employed in excavation.	20 men,	15 men.

A 4-inch pump was used at opening No. 3, and a 4-inch pump and hand pumps at opening No. 2.

Foundation. — From the end of the work described in last year's report to the end of the section a pile foundation was required. The same method of capping and laying platform as described in that report was used.

Miscellaneous. — At Bass Creek, for a distance of 82 feet, the arch was increased from 4 inches to 8 inches in thickness. Immediately under the culvert at this point, the bottom of which came into our sewer about 1½ inches, a flagstone, 8 inches in thickness, was set, which formed both the key of our arch and the bottom of the culvert.

SECTION 19 (DAY WORK), SIPHON, MALDEN RIVER, EVERETT AND MEDFORD.

Location. — From the end of the sewer already built (end of Section 17½) on the easterly bank of Malden River, Everett, underneath the river, at a point about opposite the Wellington station of the Boston & Maine Railroad, to the sewer already built (beginning of Section 20) on the westerly bank, Medford.

Assistants.

Assistant Engineer: William W. Lewis.
Foreman: Charles P. Horton.
Foreman's Assistant: Charles E. Hathaway.

NOTE. — The character of the structures on this section was described in the sixth annual report. At the time of that report the brick sewer and pipe-chamber on the Everett side, and the siphon under the Malden River, had been practically completed. During the past year the work on the Medford side has been completed, consisting of a sand-catcher, overflow, and a brick sewer connecting the sand-catcher with Section 20. The connection between the sand-catcher and the siphon is by a goose-neck.

Foundation. — The goose-neck connecting the siphon with the sand-catcher was built on a pile foundation. The stop-plank man-holes and the sand-catcher rest on a foundation of blue clay. On the end nearest the river the excavation was carried 2 feet below grade, in order to reach this clay, and refilled with bank gravel and brick-bats mixed with a moderate amount of cement.

Overflow. — The overflow is a structure about 35 feet long, with iron tide-gates. The first 25 feet is built of brick and concrete masonry. The outer 10 feet is a wooden scow. The whole structure rests on piles. The masonry portion of the overflow is 4 feet in diameter; the wooden scow 4 feet square.

Sand-catcher. — The sand-catcher is a structure of concrete, 10 feet by 11 feet 3 inches in diameter and 50 feet in length, with three stop-plank man-holes, one for the pipe already laid under the river, one for the overflow and one for an additional pipe to be laid under the river in the future if found necessary.

Sewer connecting Sand-catcher with Section 20. — The sewer connecting the sand-catcher with Section 20 is 4 feet 8 inches by 5 feet 1 inch. This is of masonry, 8 inches in thickness, resting on a foundation of hard sand shaped to fit the form of the invert, with blue clay below.

Miscellaneous. — As stated above, the work on the Everett side and the work under the river were practically finished last year. During the present year this work has been cement-washed, and a few piles which were left from the coffer-dam removed from the tidal channel. The work was practically finished about Jan. 1, 1895.

The total cost of the section is approximately $36,700.

PUMPING STATION AND CONNECTIONS, CHARLESTOWN.

Location. — The Charlestown pumping station is located on the easterly side of the Malden bridge causeway, at the northerly end of the pile structure, and, with all its connections, covers an area 150.50 feet by 72 feet.

Day Work.

The Work comprises — Foundations for engine- and boiler-house, coal-pocket foundations, pump-wells and foundations for engines, boiler foundations, chimney foundation, screen man-hole, valve man-holes, connections with tunnel, connections with main sewer and 179 feet of sea wall.

Of the above-mentioned work, the chimney foundation was finished at the date of the sixth annual report. The work on the engine- and boiler-house foundations, pump-wells and foundations for engines, screen man-hole, connections with the discharge sewer and sea wall, was in progress. During the year this work has been completed, and the coal-pocket foundations, boiler foundations, valve man-holes and connections with the tunnel constructed.

Assistants.

Assistant Engineer: Henry H. Marden, Jr.
Transitmen: Frank C. Shepherd, C. H. Smith.
Foremen: James Long, William Lindsay, M. Tallent.
Sub-foremen: James Carroll, Matthew Brennan, A. A. McCormack.
Foreman for Compressed Air Work: Henry Hertz, Daniel Hogan.
Foreman in Charge of Pumps and Machinery: Robert Craib.

Pump-wells and Engine Foundations. — At the time of the last report the three pump-wells had been excavated, well No. 3 lined with concrete, and wells No. 1 and No. 2 concreted to about the elevation of high water. During the past year the concreting in wells No. 1 and No. 2 has been finished, and the wells lined with brick masonry 8 inches in thickness. No lining of brick masonry was built in well No. 3. As the walls of the pump-wells above grade 102 form a part of the engine foundations, the concrete masonry of the two structures was built in conjunction above this point.

The work on the pump-wells and engine foundations was finished about January 10. Total cost of the work, $44,517.67.

Screen Man-hole and Machinery. — At the beginning of the year the excavation had been completed to the tunnel plates. Concrete walls were started October 4 and finished to grade 112 on October 23. Operations were then suspended until Feb. 6, 1895. At this time one of the tunnel plates was removed. There was a slight amount of leakage, and trouble was experienced in pumping the water sufficiently low to enable the men to work. It was decided to cut through the roof of the tunnel, and use this as a pump-well. Before cutting through the roof bulkheads were placed in the tunnel on each side of the screen-chamber. On February 23 a hole was cut through the roof, and at high tide, February 24, water broke into the man-hole, carried away the southerly bulkhead and flooded the tunnel. After having made an unsuccessful attempt to pump this water out, a diver was employed to repair the leak. This latter method having proved unsatisfactory, it was decided to put in an air lock and finish the chamber by the aid of compressed air. Air pressure was put on May 7, and the masonry finished to the air lock on June 10. The air lock was then removed and the masonry finished to grade 112, June 27.

For hoisting the screens, a double drum, 6¼ inches by 8 inches, Lidgerwood engine, has been provided. This engine is anchored to the floor of the screen-chamber and is furnished with steam from the boiler-room.

The screens consist of cages formed of iron frame work, 8 feet

3 inches high, 5 feet 4 inches wide and 2 feet 11 inches deep, held in position by guides, which extend to the bottom of the screen man-hole. The front side of the cage is open. The back side and the two ends are of $\frac{3}{4}$-inch rods, spaced $1\frac{3}{4}$ inches from centre to centre.

Total cost of the above-described work (including man-hole, cages, engine and hoisting rigging), $10,330.

Discharge Channels (*Connections with Main Sewer*). — At the time of making the last report excavation on these channels had commenced. At the lower portions of these, where the connection was made with the pump-wells, the work had to be done by tides. It was possible to work only two hours on each tide. These channels were under the hydraulic gradient of the sewage, hence subject to very heavy pressure, and for this reason a heavy cross-section was adopted. For the foundation, piles were driven at random, about 2 feet 6 inches on centres. Concrete was deposited around the piles to a depth of 8 inches below the tops. To prevent wash, all green concrete was covered with canvas and boards before the tide covered it.

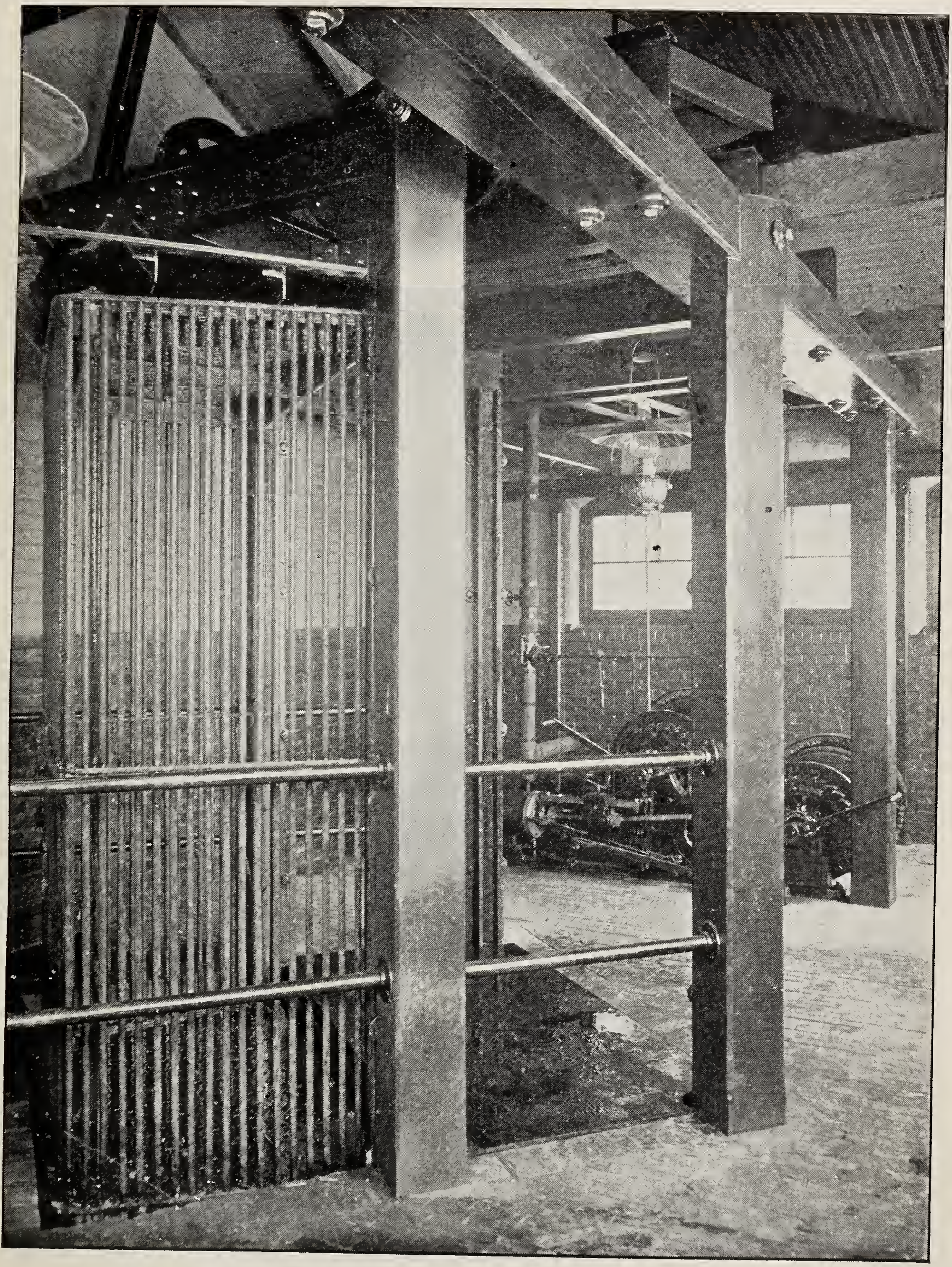
The concrete masonry on these channels was finished Nov. 23, 1894. Operations were then suspended until February, when work was commenced lining the channels with brick masonry, which was finished about April 4.

Total cost of discharge channels, $20,692.

Sea Wall. — The construction was the same as described in last year's report. Total length constructed, 179 feet; height, 16 feet; thickness of base, 10 feet; thickness of top, 4 feet 4 inches. The wall is built on piles and platform. The face is of granite, 2 feet thick; the backing of Portland concrete. Total cost of the wall, $15,604.

Coal-pocket Foundations. — The foundations for the coal-pocket consist of concrete walls 5 feet thick, resting mainly on the sewer beneath. Piles were driven to support the north-east and south-west corners. The east wall rests on existing dry wall, which formerly formed the side of a dock. Work was commenced July 21; was finished Aug. 28, 1895. Cost, $2,675.

Boiler Foundations. — For the boiler foundations a block of Portland cement concrete, 21 feet long, 16 feet 6 inches wide and 3 feet deep, was built. On this a grillage of 6-inch I-beams embedded in concrete was placed. After masonry was set, the foundation was loaded with 170 tons of sand and pig iron (about twice the weight of the boilers) to determine the settlement. As the load was applied the foundations settled, reaching a maximum



SCREEN AND HOIST, CHARLESTOWN PUMPING STATION.

of 0.16 feet with the maximum load. This load was allowed to remain, and, as no settlement occurred in six days, it was removed. There was no rising of the foundations when the load was removed. The work was commenced March 30 and finished April 20, 1895. The total cost was $993.

Valve Man-holes and Connections with Tunnel. — The excavation of these chambers was considerably below low water. Tide work was necessary. Excavation was commenced Dec. 1, 1894, The excavation was first made by working as long as possible at each tide; after this was finished the wells were lined with concrete, against forms which were afterwards removed, and a lining of brick masonry put in. Masonry in these structures was completed June 13. In man-holes No. 1 and No. 2 Penstock gates, designed and furnished by the Coffin Valve Company of Boston, were set. Just above the gates iron diaphragms with man-hole plates prevent the sewage from rising in the man-holes. The cost of this work was $9,851.

Contract Work.

State Assistants.

Architect: Arthur F. Gray.
Assistant Engineer: Henry H. Marden, Jr.
Transitmen: Frank C. Shepherd, C. H. Smith.
Building Inspector: James E. Coyne.

Contractors.

Contractors for Building. — Edward Lynch & Co. of Boston.
Contractors for Pumping Plant. — The Edward P. Allis Company of Milwaukee.
Contractors' Foreman on Pumping Plant. — Forest E. Bingham.
Contractor for Pile Pulling and Dredging. — Josiah Shaw.

Building. — The building is of brick, granite and terra cotta, consisting of an engine-room 100 feet by 31½ feet inside measurements, a boiler-room 43 feet by 31½ feet inside measurements, additional space for screen-room, toilet rooms, tool-room, economizer, and a chimney 90 feet high. This building contains the pumping machinery.

Work was commenced Oct. 5, 1894, and progressed very slowly until practically completed during July, 1895. The total cost was $18,171.31.

Pumping Plant. — The work of erecting the machinery commenced March 20, 1895. The first fires were built under the boilers July 29; engine No. 1 was first started August 3, and engine No. 2 August 10. Informal tests of the pumps were made on September 4, 5 and 6.

Pile-pulling and Dredging. — A contract was made with Josiah Shaw for pulling such piles as were driven for use during construction; also for dredging a berth for vessels along the east sea wall, and erecting a fender on the sea wall. Work began April 8; finished May 6, 1895. Cost, $1,291.

Miscellaneous. — Contracts have also been made for a heating plant, iron trench coverings in engine- and boiler-room, plastering of engine-room and floor of engine-room.

SECTION 25 (DAY WORK), CHARLESTOWN.

During the past year the high-level sewer from the pumping station to Section 24 has been scraped, pointed and cement-washed. The man-hole at the tunnel shaft on the southerly side of Mystic River has been finished at a cost of $320. There is yet remaining, the buildings erected during the construction of the tunnel to be removed; also some cleaning up of the grounds.

SECTION 25½ (DAY WORK).

Location. — From man-hole on main line of Cambridge branch, in Charlestown play-ground, opposite Arlington Avenue, to a point about 5 feet west of the east curb of Alford Street, connecting with the beginning of Section 35.

Arlington-Avenue Connection.

Diameter of sewer: 3 feet 4 inches by 4 feet 1 inch.
Length of sewer: 61 feet.

Assistants.

Assistant Engineer: Frank I. Capen.
Foreman: Michael Tallent.
Sub-foreman: William Tallent.
Transitmen: Principal — Hartley L. White.
Assistants — William M. Stodder, Geo. A. Winsor.

Character of Excavation. — Shaft: miscellaneous filling, with gravel and clay in the bottom; tunnel headings: gravel and clay.

This work was done by sinking a tunnel shaft about midway, and tunnelling in either direction. A 4-inch underdrain was laid, and a 2-inch Blake pump was used to take care of the water. The work of excavation commenced Dec. 9, 1894; was finished Jan. 24, 1895. An incline and hoisting engine were used in excavation, and a gang of about 10 men employed. The masonry was begun on Dec. 31, 1894; was finished Jan. 23, 1895.

Foundation. — For the entire length the excavation was shaped to fit the invert of the sewer, with the exception of the shaft where the sewer was built with concrete invert, lined with 4 inches of brick. The remainder of the masonry was 8 inches in thickness.

Cost. — The total cost of making this connection, including shaft, excavation of tunnel, masonry, timber, etc., was approximately $1,550.

Stop-plank Man-hole.

A stop-plank man-hole has been built, about 160 feet northerly from Arlington Avenue, at a cost of $1,120.

SECTION 31, CHARLESTOWN.

Location. — In Rutherford Avenue from Cambridge Street to Chapman Street; also from Sullivan Square through Main Street to Beach Street.

Diameters of sewers and length of each size: —

2 feet 5 inches by 3 feet 1 inch, ...	395.0 feet.
3 feet 1 inch by 3 feet 8 inches, ...	2,772.6 "
2 feet 7 inches by 3 feet 3 inches, ...	681.7 "
1 foot 3 inches (vitrified pipe), ...	659.5 "

Contractors. — Metropolitan Construction Company, Boston, Mass.
Contractors' Superintendent. — George W. Judd.
Contractors' Principal Foreman. — Patrick Porter.
Contractors' Principal Foreman on Tunnel. — John Charles.

State Assistants.

Assistant Engineer: Frank I. Capen.
Inspectors: Henry M. Woodward, Caleb Kimball.
Transitmen: Principal — Hartley L. White.
Assistants — William M. Stodder, George A. Winsor.

Trench and Tunnel.

	2 Feet 5 Inches by 3 Feet 1 Inch Sewer.	3 Feet 1 Inch by 3 Feet 8 Inches Sewer.	2 Feet 7 Inches by 3 Feet 3 Inches Sewer.	1 Foot 3 Inches Pipe Sewer.
Length of trench completed (feet), ...	353.00	2,742.60	211.20	28.00
Length of tunnel completed (feet), ...	42.00	30.00	470.50	631.50
Average depth of trench excavation to bottom of underdrain (feet), ...	27.40	23.20	22.50	31.40
Greatest depth of trench excavation to bottom of underdrain (feet), ...	33.00	24.00	23.50	32.00
Average width, top of trench (feet), . .	7.00	7.00	7.00	4.70
Average width, bottom of trench (feet), . .	4.75	5.15	4.90	4.50
Average depth from surface of ground to bottom of tunnel underdrain (feet), ...	31.80	24.00	22.00	21.80
Greatest depth from surface of ground to bottom of tunnel underdrain (feet), ...	33.30	24.00	22.50	32.00
Average width of tunnel excavation (feet), .	4.50	6.00	4.60	2.80
Volume of trench excavation per linear foot (cubic yards), ...	5.33	5.17	4.96	5.25
Volume of tunnel excavation per linear foot (cubic yards), ...	1.00	1.60	.90	0.40
Approximate cost of trench and tunnel per linear foot, including sheeting left in, excavation and refilling below masonry, backfilling, etc., ...	$7 00*	$6 60	$5 60	–†

* With regulator and sump man-hole.

† Cost of this 15-inch pipe sewer, including excavation, pipe, underdrain, concrete, masonry for man-holes, inspection, miscellaneous items, etc., $6.38 per linear foot.

Character of Earth Excavation. — Rutherford Avenue at Cambridge Street: 8 feet of clay and gravel filling, 2½ feet of peaty loam, then gravel, yellow clay and compact sand to grade; at Baldwin Street: 9 feet of gravel and sand, 2 feet of fine blue sand, then clayey gravel to grade; at Mill Street: 9 feet of miscellaneous filling, 11 feet of sand and gravel, 4 feet coarse gravel to grade; at Lincoln Street: 12 feet miscellaneous sand and gravel filling, 2 feet of sand, 8½ feet of blue clay and gravel to grade; at Chapman Street: 9 feet sand and gravel filling, 2 feet of sand, 11 feet of clayey gravel, with some sand. At first man-hole, pipe line, Main Street: 15 feet sand, gravel and clay, hard-pan to grade; at second man-hole: 8 feet sand and gravel, hard-pan to grade; at third man-hole: 5 feet of miscellaneous filling, 4 feet peat, silt and stones, 7½ feet of peat to 2½ feet below grade, coarse sand below; at fourth man-hole: 15 feet of sand, gravel and clay to grade.

Masonry.

Contract price: —

Brickwork, American cement mortar, per cubic yard,	$12 35
Brickwork, Portland cement mortar, per cubic yard,	14 25
Concrete, American cement mortar, per cubic yard,	6 86
Concrete, Portland cement mortar, per cubic yard,	7 86

Diameters of underdrain laid and length of each size: —

3-inch,	18 feet.
4-inch,	262 "
6-inch,	786 "
8-inch,	1,890 "
10-inch,	1,551 "

Approximate cost of masonry per linear foot of trench and tunnel, including underdrain, etc.: —

2 feet 5 inches by 3 feet 1 inch sewer,	$5 80
3 feet 1 inch by 3 feet 8 inches sewer,	5 05
2 feet 7 inches by 3 feet 3 inches sewer,	5 50

Length completed, trench,	3,334.80 feet.
Length completed, tunnel,	1,174.00 "

Masonry was begun June 12, 1894, and was finished April 12, 1895.

Approximate cost of section (not including pipe sewer on Main Street) per linear foot of excavation and masonry, including labor, material, inspection and miscellaneous items, to date (September 30), $12.06.

Note. — The information regarding Section 31 following this note relates solely to the year ending Sept. 30, 1895. For a description of the work performed prior to this year, see the sixth annual report.

Excavation. — Opening No. 1, mentioned in last year's report, was continued from a point on Rutherford Avenue 50 feet north of Middlesex Street to a point on Rutherford Avenue 200 feet north of Miller Street, a distance of 2,701 feet. Under local sewers, a little south of Dunstable Street, 66.5 linear feet were excavated by tunnel. The excavation on this opening was finished Jan. 24, 1895. The average progress per week was 120 feet, an average gang of 45 men being employed. When the trench reached the above point the contractors requested to be allowed to construct the remainder of the section by tunnel, and to be paid the same prices for masonry as they received on Section 32. It was decided that, as the sewer for the remainder of the distance was in the centre of the street, and, if built by open cut, would necessitate closing the same, it would be better to allow the extra price for masonry, and have the work tunnelled. Tunnel shafts were excavated at each of the two remaining man-holes, and a tunnel 404 feet long driven from these. The tunnel was started February 13 and finished March 25, with the exception of 20 feet adjoining the end of the open cut, where the tide broke through and flooded the tunnel, so that they were obliged to finish by open cut. This 20 feet was finished March 28. On Main Street it was decided to build the pipe line, from Sullivan Square to Medford Street, by tunnel, sinking shafts at each man-hole. The first 28 feet next to the main sewer was opened from the surface, and the first tunnel heading started from this. This 28 feet was started Oct. 3, 1894, and the tunnel was started October 26. The shafts were started at the other three man-holes on October 27, December 10 and December 14, respectively. The excavation in the tunnel was finished Jan. 16, 1895.

On this tunnel an "A" frame derrick was used at the first shaft, operated by a hoisting engine, which also supplied steam to run a 4-inch pulsometer, located in a small well on one side of the shaft. At the second and third shafts an incline was used, operated by a horse. At shaft No. 4 no hoisting apparatus was used, the material being raised by staging.

Pumping. — The pumping was done by a 6-inch centrifugal Lawrence pump at a well on Rutherford Avenue, 200 feet north of Baldwin Street, until December 20, when this pump was moved to a new well near Dunstable Street. A 2-inch duplex pump was used in the trench a short time, while the other pump was being moved and set up at the new well. This 2-inch duplex pump was afterwards used in the shaft 45 feet north of Miller Street. A 4-inch pulsometer was used at the tunnel shaft corner of Rutherford Avenue and Chapman Street. A 4-inch pulsometer was also used at the first shaft on the pipe line, a small well being sunk in the side of the shaft, and this took the drainage for the entire length of the branch.

Foundation. — From Essex Street to the end of the section the foundation was in sand and gravel, or clay and gravel. Where practical, this was shaped to fit the invert of the sewer; where this could not be done, a concrete invert was put in. This was necessary for about 745 feet of the total distance of about 2,100 feet. On the pipe line on Main Street the foundation was hard-pan and clay, except for about 165 feet, where peat extended below grade, the greatest depth being 2½ feet below. This was refilled with American concrete.

Difficulties and Obstructions. — The work was considerably delayed near Mill Street, an old rubble-stone wall running along with and inside the sewer trench. The trench also filled with water at high tide through a 10-inch pipe drain, which crossed the trench about 125 feet south of Mill Street, and connected with a large scow sewer in Rutherford Avenue.

A break occurred in a 12 by 36 inch wooden overflow sewer at Tibbett's town way, November 14, filling the trench half full of tide water and stopping work on masonry. After this old overflow had been cut off and bulkheaded, the work progressed.

At a point about 140 feet south of Dunstable Street, local sewers, from opposite directions on Rutherford Avenue, crossed the Metropolitan Sewer, and coming together discharged into one outlet. At this point the contractors decided to construct the Metropolitan Sewer by tunnel, and, to guard against accident, the masonry was kept well up to the heading, and the arch back-filled with solid brick masonry. The local sewers filled at every tide, and the easterly one (a wooden box already partly collapsed and in poor repair) burst at 2 P.M. Sunday, Jan. 13, 1895, owing to internal pressure caused by the tide. For a short distance this local sewer was then exposed, in order that it might be repaired temporarily, and the sewer below it built by tide work. After the masonry of the Metropolitan Sewer had been laid, the local sewer was permanently repaired and back-filled.

Precaution. — On the 15-inch pipe branch the pipe was surrounded by about 5 inches of American concrete.

Surplus Earth. — Part of the surplus material from the trench has been used for filling on low land west of Rutherford Avenue, belonging to the Boston & Maine Railroad; and the remainder from the trench, and also the surplus from the pipe line tunnel, has been used for filling at Tuft's Mill Pond.

SECTION 32 (CONTRACT WORK), CHARLESTOWN.

Location. — From Chapman Street, at Rutherford Avenue, through private land by tunnel to Front Street, through Front and Water streets to the Navy Yard at Wapping Street. Work done directly by the State intervenes from here to Chelsea Street opposite Vine Street, whence the contract work continues in Chelsea Street to Medford Street.

Diameters of sewers and length of each size: —

2 feet 7 inches by 3 feet 3 inches,	869.0 feet.
2 feet 5 inches by 3 feet 1 inch,	1,606.0 "
2 feet 3 inches by 3 feet,	608.0 "
2 feet 1 inch by 2 feet 10 inches,	678.0 "
1 foot 7 inches by 2 feet 4 inches,	943.6 "

Contractors. — Metropolitan Construction Company, Boston, Mass.
Contractors' Superintendent. — George W. Judd.
Contractors' Principal Foreman. — P. Percello.
Contractors' Principal Foreman on Tunnel. — John Charles.

State Assistants.

Assistant Engineer: Frank I. Capen.
Inspector: Caleb Kimball.
Assistant Inspector: Burton A. Clark.
Transitmen: Principal — C. Barton Pratt.
Assistant — Edward I. Marvel.

Trench and Tunnel.

	2 Feet 7 Inches by 3 Feet 3 Inches Sewer.	2 Feet 5 Inches by 3 Feet 1 Inch and 2 Feet 3 Inches by 3 Feet Sewers.	2 Feet 1 Inch by 2 Feet 10 Inches Sewer.	1 Foot 7 Inches by 2 Feet 4 Inches Sewer.
Length completed of trench excavation (feet),	–	2,141 00	594.00	943.60
Length completed of tunnel excavation (feet),	869.00	73.00	84.00	–
Average depth of trench excavation to bottom of underdrain (feet),	–	19.11	16.80	19.60
Greatest depth of trench excavation to bottom of underdrain (feet),	–	20.60	16.80	21 00
Average width, top of trench (feet),	–	6.21	5.00	4.60
Average width, bottom of trench (feet),	–	4.47	4.00	2.40
Average depth from surface of ground to bottom of tunnel underdrain (feet),	29.50	19.60	17.00	–
Greatest depth from surface of ground to bottom of tunnel underdrain (feet),	38.40	19.80	17.00	–
Average width of tunnel excavation (feet),	4.00	4.00	3.80	–
Volume of trench excavation per linear foot (cubic yards),	–	3.75	2.60	2.94
Volume of tunnel excavation per linear foot (cubic yards),	0.88	0.71	0.77	–
Approximate cost of trench per linear foot, including sheeting left in, back-filling, etc., to completion of work,	–	$5 80	$5 19	$4 34
Approximate cost of tunnel excavation per linear foot, including lumber left in, back-filling, etc., to completion of work,	$5 95	4 65	5 95	–

Character of Earth Excavation. — Front Street near beginning of trench: paving, then sand and gravel for 6½ feet, peat silt and shells to 1 foot above springing line of sewer, then blue clay mingled with sand and gravel; about opposite Arrow Street: hard blue clay took the place of sandy clay; Front Street, between Arrow and Walford streets: paving, sand, gravel and clay to 9 feet below surface, 4 feet of peat, hard blue clay to grade; opposite the easterly end of the Boston & Maine Railroad freight station: hard yellow clay took the place of the blue clay; Warren Avenue: paving, 13 feet of sand and gravel, yellow clay to grade; Water Street near Chambers Street: paving, 7 feet sand and gravel filling, sandy clay, fine sand to grade; Hudson Street and further: paving, 8 feet of sand and gravel, 1½ feet of peaty fibrous material, 1 foot of sand and peat, hard yellow clay to grade; 90 feet beyond: peat extends to grade; from this point to Wapping Street: paving, sand and gravel, then blue clay to grade; Chelsea Street from Vine Street for about 300 feet: paving, 5 feet sand and gravel, then blue clay to grade; the remainder of the section to Medford Street: hard-pan to grade.

Masonry.

Contract price: —

Brickwork, American cement mortar, per cubic yard, trench,	$12 35
Brickwork, American cement mortar, per cubic yard, tunnel,	15 08
Brickwork, Portland cement mortar, per cubic yard, trench,	14 45
Brickwork, Portland cement mortar, per cubic yard, tunnel,	17 08
Concrete, American cement mortar, per cubic yard,	5 86
Concrete, Portland cement mortar, per cubic yard, trench,	7 86
Concrete, Portland cement mortar, per cubic yard, tunnel,	9 25

Diameters of underdrain laid and length of each size: —

4-inch,	175 feet.
6-inch,	774 "
8-inch,	2,708 "
10-inch,	102 "

Approximate cost of masonry per linear foot of excavation, including underdrain, etc.: —

1 foot 7 inches by 2 feet 4 inches sewer, in trench,	$1 78
2 feet 5 inches by 3 feet 1 inch and 2 feet 3 inches by 3 feet sewer, in trench,	4 30
2 feet 1 inch by 2 feet 10 inches sewer, in trench,	2 56
2 feet 7 inches by 3 feet 3 inches sewer, in tunnel,	5 71

Length of masonry completed: —

1 foot 7 inches by 2 feet 4 inches sewer, in trench,	944 feet.
2 feet 5 inches by 3 feet 1 inch and 2 feet 3 inches by 3 feet sewer, in trench,	2,214 "
2 feet 1 inch by 2 feet 10 inches sewer, in trench,	594 "
2 feet 1 inch by 2 feet 10 inches sewer, in tunnel,	84 "
2 feet 7 inches by 3 feet 3 inches sewer, in tunnel,	869 "

Masonry was begun in trench June 8, 1894, and was finished Jan. 8, 1895.

Masonry was begun in tunnel June 6, 1894, and was finished March 16, 1895.

Approximate cost of section per linear foot of excavation and masonry, including labor, material, inspection and miscellaneous items to completion of work, $9.76.

NOTE. — The information regarding Section 32 (contract work) following this note relates solely to the year ending Sept. 30, 1895. For a description of the work performed prior to this year, see the sixth annual report.

Excavation.

	Opening No. 3.	Opening No. 4.	Opening No. 6.	Opening No. 7.
Character of opening.	Tunnel, . .	Open cut, . .	Tunnel, . .	Open cut.
Number of tunnel headings.	One, . . .	–	One, . . .	–
Date of starting,	July 26, 1894, .	Aug. 18, 1894, .	Oct. 27, 1894, .	Nov. 6, 1894.
Point of continuing from last year's work.	120 feet from centre of Front Street, opposite Fourth Street.	Near Gray Street on Water Street.	At Wapping Street.	Chelsea Street at Vine Street.
Point of ending,	Middle of Front Street below Fitchburg and Boston & Maine freight stations, opposite Fourth Street produced.	At Wapping Street.	Entrance to Navy Yard.	Medford Street.
Date of completion.	Oct. 20, 1894, . .	Oct. 27, 1894, .	Nov. 15, 1894, .	Jan. 1, 1895.
Extent, . .	120 feet, . .	571 feet, . .	84 feet, . .	944 feet.
Ordinary progress per week.	40 feet, . . .	144 feet, . .	40 feet, . .	118 feet.
Appliances used,	Incline, . .	Trench machine,	Tripod, . .	Trench machine.
Size of gang ordinarily employed.	8 men, . . .	32 men, . .	4 men, . .	32 men.

The pumping for the whole of the open cut, from the beginning on Front Street opposite Fourth Street to the Navy Yard, was done by a 6-inch centrifugal pump. A 2-inch Blake pump was used at the tunnel shaft on Lynde Street. These were mentioned in last year's report. On Chelsea Street no pumping was required excepting the occasional use of a hand pump.

Foundation. — On Water Street, for the entire distance built this year from Gray Street to Wapping Street, the excavation has been shaped to fit the invert of the sewer. This excavation has been in blue clay or sandy blue clay. On Chelsea Street, beginning at Vine Street, for 200 feet the foundation was of blue clay; for the remainder of the distance to Medford Street, 744 feet, the foundation was hard-pan. The excavation was made to fit the invert of the sewer for the entire distance on Chelsea Street.

Miscellaneous. — On Chelsea Street but one track of the Boston & Lynn Railroad could be used while the sewer was being constructed, and for about 100 feet near Vine Street one track had to be taken up and relaid.

The sewer was built through Chelsea Street, from Vine Street to Medford Street, instead of through Vine, Decatur and Medford streets, the contractors having been given their option in the contract as to which route should be taken.

Section 32 (Day Work), Charlestown Navy Yard.

Location.—From just outside the Wapping-street entrance to the Navy Yard to about 20 feet inside of the gates by tunnel; by open cut for 150 feet parallel to the storehouse, thence through gun park and shot park and between the muster house and sail loft; thence parallel to the ropewalk for a distance of about 250 feet; thence turning to the left under the ropewalk by tunnel to Chelsea Street nearly opposite Vine Street.

Diameters of sewers and length of each size:—

2 feet 1 inch by 2 feet 10 inches,	991.50	feet.
1 foot 10 inches by 2 feet 7 inches,	565.00	"
1 foot 7 inches by 2 feet 4 inches,	15.50	"

Assistants.

Assistant Engineer: F. I. Capen.
Foreman: George F. Greenlaw.
Transitmen: Principal—C. Barton Pratt.
Assistant—Edward I. Marvel.

Character of Earth Excavation.—Just inside Wapping-street entrance to Navy Yard: 4 inches of asphalt paving, 2 inches sand, 4 inches concrete, 4 inches sand, about 5½ feet sand and gravel, clay to grade; just before entering gun park: paving, sand and gravel to 10 feet below surface, coarse gravel to grade; after entering gun park: 2 feet of loam, yellow sandy clay to grade; about the middle of the gun park: loam, fine sand and clay, then sand and gravel and yellow clay to about 100 feet within the shot park; for 82 feet in the shot park a masonry foundation for storing shot and shell was passed through, consisting of a brick floor, 10 inches of concrete resting on granite blocks about 2 feet thick; just beyond this masonry foundation and extending to the roadway between the shot park and the muster house: loam, 5 feet of sand and gravel, then yellow clay and gravel to grade; then for a distance of about 300 feet: loam, 6 feet sand and gravel filling and peat; this peat extends below the water line of sewer for about 200 feet between the sail loft and ropewalk, and for about 50 feet of this the peat extends below grade; here many old timbers and stumps of trees were found; the remaining portion of the excavation was loam, sand and gravel filling, blue clay to grade; the excavation in the tunnel, under the ropewalk, was hard blue clay.

Diameters of underdrain and length of each size:—

6-inch,	490	feet.
8-inch,	848	"

Length of masonry completed:—

Masonry in trench,	1,309	"
Masonry in tunnel,	263	"

Masonry was begun in trench July 19, 1894, and completed Jan. 3, 1895.

Masonry was begun in tunnel Aug. 1, 1895, and completed Dec. 13, 1895.

Approximate cost of section per linear foot of excavation and masonry, including labor, material and miscellaneous items to completion of work, $12.29.

Approximate cost of masonry per linear foot of trench, including underdrain, labor, bills, etc., $3.50.

Approximate cost of masonry per linear foot of tunnel, including underdrain, labor, bills, etc., $3.03.

Trench and Tunnel.

	2 Feet 1 Inch by 2 Feet 10 Inches.	1 Foot 10 Inches by 2 Feet 7 Inches.	1 Foot 7 Inches by 2 Feet 4 Inches.
Length completed of trench excavation (feet),	951.5	357.5	–
Length completed of tunnel excavation (feet),	40.0	207.5	15.5
Average depth of trench excavation to bottom of underdrain (feet),	18.8	16.5	–
Greatest depth of trench excavation to bottom of underdrain (feet),	21.5	17.0	–
Average width, top of trench (feet),	5.5	4.5	–
Average width, bottom of trench (feet),	4.5	3.5	–
Average depth from surface of ground to bottom of tunnel underdrain (feet),	16.8	16.3	17.0
Average width of tunnel excavation (feet),	3.3	3.5	3.3
Volume of trench excavation per linear foot (cubic yards),	3.34	2.44	–
Volume of tunnel excavation per linear foot (cubic yards),	.59	.64	.50

Approximate cost of trench per linear foot, 2 feet 1 inch by 2 feet 10 inches, and 1 foot 10 inches by 2 feet 7 inches sewers, including sheeting left in, back-filling, etc., to completion, $9.87.

Approximate cost of tunnel excavation per linear foot, 2 feet 1 inch by 2 feet 10 inches, 1 foot 10 inches by 2 feet 7 inches and 1 foot 7 inches by 2 feet 4 inches sewers, including lumber left in, etc., $3.93.

NOTE. — The information regarding Section 32 (day work) following this note relates solely to the year ending Sept. 30, 1895. For a description of the work performed prior to this year, see the sixth annual report.

Excavation.

	Opening No. 1.	Opening No. 2.	Opening No. 3.
Character of opening.	Open cut,	Tunnel,	Tunnel.
Number of tunnel headings.	–	Two,	One.
Date of starting,	July 12, 1894,	Oct. 1, 1894,	Nov. 15, 1894.
Point of beginning,	–	About 63 feet from ropewalk in Navy Yard, opposite Vine Street.	In sidewalk east side Chelsea Street, opposite Vine Street.
Point of ending,	Between ropewalk and sail loft.	Under sidewalk on east side of Chelsea Street, opposite Vine Street.	About 27 feet into Chelsea Street from sidewalk opposite Vine Street.
Date of finishing,	Dec. 6, 1894,	Dec. 20, 1894,	Nov. 24, 1894.
Length,	698 feet,	150 feet,	27 feet.
Ordinary progress per week.	72 feet,	60 feet (2 shifts),	48 feet (2 shifts).
Appliances used,	Trench machine,	Tripod (1 bucket hoisted by horse-power).	Tripod (1 bucket hoisted by horse-power).
Gang ordinarily employed.	50 men,	4 men,	4 men.

A No. 5 pulsometer at a well just outside the gun park took care of the ground water.

Foundation. — From the beginning of the work to the middle of the gun park, a distance of 513 feet, with the exception of 54 feet, the foundation has been in clay and sandy clay, which has been shaped to fit the invert of the sewer. For the intervening space of 54 feet the bottom of the excavation was coarse gravel. The sewer was here built in a cradle. From the middle of the gun park to about 40 feet within the shot park the bottom of the excavation has been sandy clay and the sewer has been built with a concrete foundation; then to 100 feet beyond the road between the shot park and the muster house, a distance of 375 feet, yellow clay and gravel, where the bottom was shaped to fit the invert of the sewer. From here, for a distance of 165 feet, peat was found below the water line of the sewer, requiring a concrete foundation; for 50 feet of this 165 feet the peat extended 3.5 feet below grade. The remaining portion of the work is through hard blue clay for a distance of 298 feet, where the excavation was shaped to the form of the invert.

Miscellaneous. — Between the ropewalk and the sail loft there were several large pieces of hard-wood timber found about 10 feet below the surface, which had to be cut out and removed from the trench. At this same point there were many posts and trunks of trees removed from the trench. There were also in this same locality two local sewers which were passed under by tunnelling. Under one of these sewers the peat extended 3.5 feet below grade. This was excavated, and the excavation refilled to grade with specially-mixed American concrete. Considerable care had to be taken to prevent floodings from the tide water which backed up into these sewers. The arch of the Metropolitan Sewer in the tunnels under these local sewers was back-filled with solid brick masonry. The surplus earth from the excavation has been used for filling in low land on Medford Street.

SECTION 35, CHARLESTOWN, SOMERVILLE AND MEDFORD.

Location. — From Alford Street, at Arlington Avenue, Charlestown, through Arlington Avenue, across the Grand Junction and Boston & Maine Railroad tracks and through Mousal Place to North Union Street; thence through private land to Mystic Avenue near Austin Street, and through Mystic Avenue to a point in Medford a few feet beyond the Somerville and Medford line.

Diameters of sewers and length of each size: —

3 feet 4 inches by 4 feet 1 inch,	920 feet.
3 feet 3 inches by 3 feet 11 inches,	2,459 "
2 feet 11 inches by 3 feet 7 inches,	707 "
1 foot 10 inches by 2 feet 3 inches,	4,285 "

Contractors. — James Heath & Son of Lynn, Mass.
Contractors' Principal Foreman. — William Hall.

State Assistants.

Assistant Engineer: Frank I. Capen.
Inspectors: M. F. Garra, Caleb Kimball, B. L. Sykes, Paul W. Rowell.
Transitmen: Principals — Paul W. Rowell, Hartley L. White, G. A. Winsor.
Assistants — Wm. M. Stodder, G. A. Winsor.

Trench and Tunnel.

	3 Largest Sewers.	Smallest Sewer.
Length of trench completed (feet),	239.00	3,781.00
Length of tunnel completed (feet),	3,926.00	–
Average depth of trench excavation to bottom of underdrain (feet),	29.00	21.70
Greatest depth of trench excavation to bottom of underdrain (feet),	30.00	24.20
Average width, top of trench (feet),	7.50	4.50
Average width, bottom of trench (feet),	6.10	4.20
Average depth from surface of ground to bottom of tunnel underdrain (feet),	29.00	–
Greatest depth from surface of ground to bottom of tunnel underdrain (feet),	34.50	–
Average width of tunnel excavation (feet),	5.50	–
Volume of trench excavation per linear foot (cubic yards),	7.00	3.30
Volume of tunnel excavation per linear foot (cubic yards),	1.50	–
Approximate cost of trench per linear foot, including sheeting left in, back-filling, etc., to date (September 30),	$6 45	$4 15*
Approximate cost of tunnel excavation per linear foot, including sheeting left in, back-filling, etc., to date (September 30),	6 55	–

* This includes rock excavation for 1,305 linear feet, averaging 6.6 feet in depth.

Character of Earth Excavation. — From the beginning of the section for 3,630 feet (with the exception of about 240 feet of open trench on Mystic Avenue, above Austin Street) the tunnel was driven through clay or gravelly clay; then for 534 feet the tunnel was driven through peat, silt and clay, the peat and silt extending for a distance of 100 feet to an average depth of 1.3 feet below grade. At the beginning of the open cut at Winthrop Street, on Mystic Avenue: 5 feet broken stone, 8 feet of peat, clay below to grade; at a point about opposite Temple Street: 1 foot quarry chips, 10 feet of clay, ledge below. Ledge first appears at Temple Street, and extends 189 feet; it then runs out for 420 feet, appearing again in the bottom and extending 88 feet; it is then lost for 281 feet, appearing again in the bottom and extending 246 feet; it is then lost for 85 feet, appearing again in the bottom and extending about 520 feet, and is now below water line (not below underdrain). On the opening beginning at Station 76 + 67 (about 695 feet south of Medford and Somerville line) found no ledge for 305 feet; then ledge extended 249 feet.

Masonry.

Contract price: —	
Brickwork, American cement mortar, per cubic yard,	$14 00
Brickwork, Portland cement mortar, per cubic yard,	15 00
Concrete, American cement mortar, per cubic yard,	6 00
Concrete, Portland cement mortar, per cubic yard,	7 00
Diameters of underdrain and length of each size: —	
4-inch,	1,374 feet.
6-inch,	5,074 "
Approximate cost of masonry per linear foot of excavation, including underdrain, etc., to date (September 30): —	
3 feet 3 inches by 3 feet 11 inches sewer, trench,	$5 25
1 foot 10 inches by 2 feet 3 inches sewer, trench,	2 25
3 feet 4 inches by 4 feet 1 inch and 3 feet 3 inches by 3 feet 11 inches sewers, tunnel,	4 45
2 feet 11 inches by 3 feet 7 inches sewer, tunnel,	5 78
Length of masonry completed: —	
3 feet 3 inches by 3 feet 11 inches sewer, trench,	214 feet.
1 foot 10 inches by 2 feet 3 inches sewer, trench,	3,709 "
3 largest sewers, tunnel,	3,872 "
Smallest sewers, tunnel,	54 "
Masonry was begun in tunnel June 20, 1894, and was finished April 11, 1895.	
Masonry was begun in trench July 16, 1894, and is now (September 30) in progress.	
Approximate cost of excavation per linear foot of excavation and masonry, including labor, material, inspection and miscellaneous items, to date (September 30): —	
3 feet 4 inches by 4 feet 1 inch and 3 feet 3 inches by 3 feet 11 inches sewers, trench and tunnel,	$11 95
2 feet 11 inches by 3 feet 7 inches sewer, tunnel,	12 45
1 foot 10 inches by 2 feet 3 inches sewer, trench,	6 75

NOTE. — The information regarding Section 35 following this note relates solely to the year ending Sept. 30, 1895. For a description of the work performed prior to this year, see the sixth annual report.

Excavation and Tunnel Methods. — The two tunnels spoken of in last year's report were continued until finished. The tunnel on that portion of the work below Mystic Avenue was completed Dec. 3, 1894, the total length of tunnel excavated since the last report being 880 feet. The tunnel on Mystic Avenue was finished March 13, 1895, the total length excavated since the last report being 914 feet. Below Mystic Avenue the excavation in the tunnel was made to fit the invert of the sewer, and on Mystic

Avenue to within 320 feet of the end, where the excavation was in peat, a concrete invert was used. The work in each tunnel heading was ordinarily carried on in two shifts, eight men working on each. The ordinary progress per week in each heading has been about 12 feet. "A" frame derricks have been used on all the tunnel shafts, during the past year, for hoisting. Usually one engine did the hoisting for two shafts. The tunnelling has been carried on by the ordinary timber method.

Where the work was carried on by open cut Carson trench machines have been used. The open cut, mentioned in last year's report, beginning on Mystic Avenue at Winthrop Avenue, has been continued from Temple Street on. Owing to the large amount of rock excavation and the methods employed by the contractors, the progress has been very slow, and the work is still unfinished. The average progress per week has been about 37 feet, and the average gang employed on this opening about 16 men. On June 7 an opening was started about 694 feet south of the Somerville and Medford line. The excavation on this opening has progressed about 508 feet. For 305 feet no ledge was encountered in this trench. It then appeared in the bottom, and has not yet entirely disappeared. Work on this opening is still in progress. The ordinary progress per week has been about 32 feet, and the average gang employed about 16 men.

Miscellaneous. — The water in the tunnel has been usually removed in the large buckets which were used for hoisting excavated material. At one tunnel heading on Mystic Avenue a 1-inch steam ejector was used. Hand pumps were used in the trench until the excavation reached Temple Street. Just beyond Temple Street a pump-well was sunk and a 4-inch centrifugal pump used. On the opening started June 7 a pump-well was excavated and a 6-inch centrifugal pump used.

Difficulties. — On the portion of the tunnel in Mystic Avenue, where the excavation was in peat, considerable difficulty was experienced with gas in the tunnel heading. To overcome this a blower was stationed at the shaft and air blown into the heading.

On the opening near the end of the section the excavation of the trench was near the bank of the river. Here the water entered quite freely at high tide, necessitating tide work.

SECTION 37 (ABANDONED WORK), EAST BOSTON.

Location. — From a point in Chelsea Street about 200 feet from Chelsea Creek bridge to Prescott Street, and in Prescott and Bremen streets to a point about 300 feet beyond Brooks Street.

Assistants.

Assistant Engineer: Seth Peterson.
Foreman: Michael Tallent.
Transitmen: Principal — T. T. Cass.
Assistant — David H. Winslow.

At the beginning of the year there remained about 100 feet of sewer to be completed on this section. This was at a point near the end of the section, about 250 feet south of Brooks Street. At this point the Bremen-street sewer crossed diagonally the trench of the Metropolitan Sewer. There was also an old outlet consisting of a wooden scow 4 feet square, which connected with the local sewer at this point. The contractor made several unsuccessful attempts at tunnelling under these sewers, but after a time abandoned this method. He then decided to convey the sewage across the trench of the Metropolitan Sewer by an iron pipe. He delayed in making a start on this for some time; then finally, after working a few days, abandoned the work for two weeks. On November 3 the commissioners took the work from him and completed it by day labor

In order to complete this work, the portion of the local sewer which came on the line of the Metropolitan Sewer trench was removed, and the sewage from the sewer north of this point was conveyed across the trench into the wooden scow by a 24-inch iron pipe. On the southerly side a bulkhead was built in the local sewer, and sewage below this point discharged through the outlet at Porter Street.

The timbers used in the tunnel by the contractor made the excavation somewhat more difficult than it would have been had the work been done before attempts were made at tunnelling. The bottom of the excavation was in fine wet sand. The work of putting in the iron pipes and stopping leaks in the local sewer was finished November 15, at which time work was resumed on the Metropolitan Sewer. This was completed in January, after which the city sewer was rebuilt. The trench to the level of the arch of the Metropolitan Sewer was back-filled with Portland cement concrete, and a pier of American cement concrete put in to support the city sewer. This work was finished March 1, 1895.

Cost of excavation per linear foot for the whole section, ...	$6 15
Cost of masonry per linear foot for the whole section, ...	5 35
Total cost per linear foot for the whole section, including excavation, masonry, inspection, etc., ...	11 85

SECTION 37½ (DAY WORK).

This section was practically completed at the beginning of the year. During the year the masonry was cleaned, pointed and cement-washed at an expense of about $150.

SECTION 38, EAST BOSTON.

Location. — From a point in Bremen Street, about 300 feet south of Brooks Street, through Bremen, Decatur, Orleans, Maverick and Jeffries streets to Sumner Street; also a branch from corner of Maverick and Orleans streets, through Orleans and Marginal streets, to about 800 feet beyond Cottage Street.

Diameters of sewers and length of each size: —

3 feet by 3 feet 5 inches,	1,025 feet.
2 feet circular (vitrified pipe),	45 "
1 foot 6 inches (vitrified pipe),	1,519 "
1 foot 3 inches (vitrified pipe),	4,294 "
1 foot (vitrified pipe),	1,346 "

Contractors. — James Heath & Son of Lynn, Mass. Mr. James Heath has acted as his own superintendent.

Contractors' Principal Foremen. — Thomas Heath, William Hall, John Heath.

State Assistants.

Assistant Engineer: Seth Peterson.
Inspectors: George A. Chase, L. M. S. Horton, J. J. Conway.
Transitmen: Principals — Thomas T. Cass, George F. Chase.
Assistants — David H. Winslow, W. G. Crispin, O. F. Barnes.

Trench and Tunnel.

	3 Feet by 3 Feet 5 Inches Sewer.	2 Feet Pipe Sewer.	1 Foot 6 Inches Pipe Sewer.	1 Foot and 1 Foot 3 Inches Pipe Sewer.
Length completed of trench and tunnel (feet),	1,025.00	45.00	1,519.00	5,640.00
Average depth of trench excavation to bottom of underdrain (feet),	24.00	21.00	20.00	17.00
Greatest depth of trench excavation to bottom of underdrain (feet),	25.00	21.00	23.00	19.00
Average width, top of trench (feet),	7.10	5.20	5.10	4.30
Average width, bottom of trench (feet),	5.50	4.60	4.30	3.90
Average depth from surface of ground to bottom of tunnel excavation (feet),	–	–	20.00	–
Greatest depth from surface of ground to bottom of tunnel excavation (feet),	–	–	20.00	–
Average width of tunnel excavation (feet),	–	–	3.50	–
Volume of trench excavation per linear foot (cubic yards),	5.80	3.90	3.50	2.60
Volume of tunnel excavation per linear foot (cubic yards),	–	–	0.70	–
Approximate cost of trench per linear foot, including sheeting left in, excavation and refilling below masonry, back-filling, etc.,	$6 30	$7 10*†	$4 60†	$3 70†
Approximate cost of tunnel excavation per linear foot, including excavation and refilling below masonry, back-filling, etc.,	–	–	3 30	–

* Surrounded by concrete. † Including pipe.

Character of Earth Excavation. — Beginning of section (in Bremen Street, about 300 feet south of Brooks Street): 9 feet of clay and gravel filling, then 4 feet of peat, 3 feet of dry sand, wet sand to grade, so fine that 89 per cent. went through a sieve having 10,000 meshes to the square inch and 25 per cent. went through one having 32,400 meshes to the square inch This formation has extended for practically the entire length of the work done on Bremen Street to 150 feet south of Porter Street; at corner of Bremen and Gove streets: 8 feet clay and gravel filling, 2 feet peat, clay to grade. This merges into previous section at 500 feet south of Porter Street. The tunnel under the railroad tracks was all in clay; corner of Decatur and Orleans streets: 5 feet of clay and gravel filling, 2 feet of clay, 5 feet of peat, clay to grade; corner of Orleans and Maverick streets: 8 feet of clay and gravel filling, 2½ feet of peat, fine sand mixed with clay below. These last two formations merged into each other about 200 feet south of the corner of Orleans and Decatur streets; at corner of Maverick and Cottage streets: 7½ feet clay and gravel filling, 2 feet peat, 1 foot sand, clay to grade; about 1,000 feet east of Cottage Street: the clay in the bottom of the trench changed to sand, which continued to Jeffries Street, where the whole depth of the trench is filling of clay and gravel; in Jeffries Street the material was clay mixed with sand and gravel; in Orleans Street, from Maverick Street to Marginal Street: paving, 8 feet clay and gravel filling, 3 feet peat, fine sand and gravel to grade; from the corner of Orleans Street on Marginal Street for a length of about 400 feet: paving, 9 feet clay and gravel filling, sea wall to about water line, clay below; at Cottage Street: paving, 5 feet filling, clay mixed with gravel to grade. This formation extends practically to the end of the section.

Masonry.

Contract price: —

Brickwork, American cement mortar, per cubic yard,	$13 50
Brickwork, Portland cement mortar, per cubic yard,	15 50
Concrete, American cement mortar, per cubic yard,	6 00
Concrete, Portland cement mortar, per cubic yard,	7 00

Diameters of underdrain laid and length of each size: —

4-inch,	467 feet.
6-inch,	4,973 "
8-inch,	1,156 "
10-inch,	1,484 "
Length of masonry completed,	1,025 "

Masonry was begun on brick sewer June 11, 1894; finished Aug. 11, 1894.

Approximate cost of masonry per linear foot of trench, including underdrain, etc., to date (Sept. 30, 1895), $5.70.

Pipe.

Contract price (including excavation, pipe and laying, etc.): —

1 foot 6 inches vitrified pipe, per linear foot,	$3 24
1 foot 3 inches and 1 foot vitrified pipe, per linear foot,	2 57
Length of sewer pipe laid,	7,204 feet.

Pipe laying began Aug. 16, 1894; finished Sept. 6, 1895.

Approximate cost of masonry per man-hole (pipe sewer), $90.60.

Approximate cost of section per linear foot of excavation, masonry and pipe, including labor, material, inspection and miscellaneous items to completion: —

Masonry sewer,	$12 60
Pipe sewer,	5 90

NOTE. — The information regarding Section 38 following this note relates solely to the year ending Sept. 30, 1895. For a description of the work performed prior to this year, see the sixth annual report.

Excavation.

	Opening No. 1.	Opening No. 2.	Opening No. 3.	Opening No. 4.	Opening No. 5.	Opening No. 6.	Opening No. 7.
Character of opening,	Open cut,	Open cut,	Tunnel,	Open cut,	Open cut,	Open cut,	Open cut.
Date of starting,	May 21, 1894,	Aug. 20, 1894,	Nov. 24, 1894,	Nov. 26, 1894,	Oct. 29, 1894,	Jan. 24, 1895,	July 29, 1895.
Point of beginning,	Bremen Street, 150 feet south of Porter Street.	Corner Orleans and Maverick streets.	Corner Bremen and Gove streets, and just across the tracks.	Corner Orleans and Maverick streets.	Corner Jeffries and Maverick streets.	Corner Orleans and Marginal streets.	Corner Orleans and Marginal streets.
Points of ending,	Corner Bremen and Gove streets.	Corner Orleans and Marginal streets.	Headings met under railroad tracks.	Corner Maverick and Jeffries streets.	Corner Jeffries and Sumner streets.	800 feet east of Cottage Street on Marginal Street.	Just across Marginal Street.
Date of finishing,	Nov. 24, 1894,	Jan. 24, 1895,	Dec. 5, 1894,	June 8, 1895,	Jan. 17, 1895,	Aug. 1, 1895,	Aug. 29, 1895.
Length,	500 feet,	1,044 feet,	114 feet,	2,555 feet,	450 feet,	1,467 feet,	28 feet.
Ordinary progress per week.	96 feet,	80 feet,	48 feet,	100 feet,	180 feet,	96 feet,	7 feet.
Appliances used,	Trench machine,	Trench machine,	Wheelbarrows in tunnel and staging at shaft.	Trench machine,	By hand,	Trench machine,	By hand.
Gang ordinarily employed,	15 men,	25 men,	8 men,	25 men,	30 men,	18 men,	9 men.

Two 6-inch centrifugal pumps were required to take care of the water; one on Bremen Street 200 feet south of Porter Street; and one on Orleans and Decatur streets. These were moved to the corner of Orleans and Maverick streets and to the corner of Marginal and Clyde streets. Estimated average pumpage, 1,000,000 gallons per twenty-four hours.

The progress of the work was slightly delayed by shut-downs, owing to cold weather and failure on the part of the contractor to pay the men promptly.

Foundation. — For about 325 feet on Bremen Street, 400 feet on Orleans Street near Maverick Street, 150 feet on Orleans Street near Marginal Street and 200 feet on Jeffries Street, it was found necessary to excavate below grade and refill with other material. In the tunnel under the railroad tracks it was found necessary to excavate 6 inches below grade and refill with concrete. On Orleans and Bremen streets the excavation was carried 1 foot below grade and on Jeffries Street 6 inches below grade, and refilled with gravel.

Difficulties. — Near the corner of Marginal and Orleans streets an old sea wall was encountered, along which the tide water followed and came into the trench quite freely. Tide work was necessary in this vicinity.

Surplus Earth. — Surplus earth has been disposed of by carting to the dump off Maverick Street.

Miscellaneous. — At the corner of Maverick and Jeffries streets the line was changed slightly to avoid a water-gate, also to avoid the placing of a man-hole directly in front of a driveway.

SECTION 39 (CONTRACT WORK), EAST BOSTON.

Location. — From the southerly side of Central Square, through Border and Condor streets to Meridian Street, with branch from Central Square through Border, Maverick and New streets to Sumner Street.

Length of the whole contract section,	5,192 feet.
Diameters of sewers and length of each size: —	
1 foot 3 inches,	1,998 "
1 foot,	3,194 "

Contractors. — Metropolitan Construction Company of Boston, Mass.
Contractors' Superintendent. — George W. Judd.
Contractors' Principal Foremen. — John Colleran (trench), J. Charles (tunnel).

State Assistants.

Assistant Engineer: Seth Peterson.
Inspector: L. M. S. Horton.
Transitmen: Principals — E. S. Foster, G. F. Chase.
Assistants — G. F. Chase, D. H. Winslow, H. L. Morrow, W. G. Crispin, B. A. Clark, H. L. Ward, J. J. Comfrey.

Trench and Tunnel.

Length of trench excavated to bottom of underdrain,	4,527.0 feet.
Length of tunnel excavated to bottom of underdrain,	665.0 "
Average depth of trench excavation to bottom of underdrain,	16.0 "
Greatest depth of trench excavation to bottom of underdrain,	23.0 "
Average width, top of trench,	4.3 "
Average width, bottom of trench,	3.3 "
Average depth from surface of ground to bottom of tunnel excavation,	17.0 "
Greatest depth from surface of ground to bottom of tunnel excavation,	21.0 "
Average width of tunnel excavation,	3.0 "
Volume of trench excavation per linear foot,	2.25 cu. yds.
Volume of tunnel excavation per linear foot,	0.50 " "

Approximate cost of trench per linear foot, including pipe, sheeting left in, excavation and refilling below masonry, back-filling, etc., to completion of work, $4.05.

Approximate cost of tunnel excavation per linear foot, including pipe, excavation and refilling below masonry, back-filling, etc., to completion of work, $3.25.

Character of Earth Excavation. — South-west side of Central Square: paving, 6 feet of clay and gravel filling, 8 feet of peat, 3 feet of sand, clay below; about 150 feet south of Lexington Street: paving, 2 feet of sand and gravel filling, coarse sand below. These two formations merge into each other at the junction of Border Street and Central Square. At Eutaw Street: paving, 6 feet of gravel filling, sand and gravel, mingled with clay. This formation and the formation 150 feet south of Lexington Street merge about 200 feet north of Lexington Street. Five hundred feet north of Eutaw Street: paving, 1 foot of gravel filling, clay, gravel and bowlders. This formation and the one at Eutaw Street merge about 400 feet north of Eutaw Street. Falcon Street to Meridian Street: paving, clay and gravel filling to bottom of trench. In Border Street, south of Central Square, the section changes at a point about 200 feet north of Decatur Street: paving, 10 feet filling, 2 feet peat, 2 feet coarse sand, fine sand to grade; at Maverick Street: paving, 6 feet filling, 1 foot peat, clay to grade. These formations merge about 300 feet north of Maverick Street. From corner of Maverick and New streets to Sumner Street (tunnel): clay.

Masonry.

Contract price: —

Brickwork, American cement mortar, per cubic yard,	$12 79
Brickwork, Portland cement mortar, per cubic yard,	14 50
Concrete, American cement mortar, per cubic yard,	5 50
Concrete, Portland cement mortar, per cubic yard,	7 00

Diameters of underdrain laid and length of each size: —

4-inch,	230 feet.
6-inch,	246 "
8-inch,	2,924 "
10-inch,	362 "

Approximate cost of masonry per man-hole, $65.70.

Pipe laying began in trench June 19, 1894; finished March 26, 1895.

Pipe laying began in tunnel March 26, 1895; finished May 1, 1895.

Approximate cost of section per linear foot of excavation and masonry, including labor, material, inspection and miscellaneous items, to completion of work, $4.65.

NOTE. — The information regarding Section 39 following this note relates solely to the year ending Sept. 30, 1895. For a description of the work performed prior to that date, see the sixth annual report.

Excavation.

	Opening No. 2.*	Opening No. 3.	Opening No. 4.	Opening No. 5.	Opening No. 6.	Opening No. 7.
Character of opening.	Open cut,	Open cut,	Tunnel,	Tunnel,	Tunnel,	Tunnel.
Number of tunnel headings.	–	–	Two,	Two,	Two,	One.
Date of starting,	Continued,	Nov. 22, 1894,	March 26, 1895,	March 28, 1895,	April 5, 1895,	April 5, 1895.
Point of beginning or point of continuing from last year's work.	250 feet south of White Street.	Central Square,	Corner Maverick and New streets.	150 feet south of Maverick Street on New Street.	300 feet south of Maverick Street.	Corner Sumner and New streets.
Point of ending,	Falcon Street,	Corner Maverick and New streets (33 feet tunnelled under Maverick Street).	Across Maverick Street and 82 feet south of Maverick Street on New Street.	82 feet south of Maverick Street and 55 feet south of shaft.	100 feet north and 90 feet south of shaft.	80 feet north of shaft.
Date of finishing,	Dec. 6, 1894,	March 23, 1895,	April 2, 1895,	April 5, 1895,	April 18, 1895,	April 18, 1895.
Extent,	647 feet,	1,423 feet,	114 feet,	130 feet,	190 feet,	80 feet.
Ordinary progress per week.	100 feet,	100 feet,	114 feet,	112 feet,	90 feet,	40 feet.
Appliances used,	Trench machine,	Trench machine,	Trench machine,	Trench machine,	Trench machine,	Incline.
Gang ordinarily employed.	30 men,	30 men,	16 men,	16 men,	16 men,	16 men (employed portion of time).

* In opening No. 2 several tunnels, about sixteen feet in length, were driven.

One 6-inch centrifugal pump in Central Square, and 2 pulsometers at Decatur Street (for a short time) were required to take care of the water. The greatest estimated rate of pumpage for twenty-four hours was 1,200,000 gallons.

The work was delayed by one shut-down of a week's duration, owing to the tide breaking into the trench and the extreme cold weather.

Foundation. — The bottom of the trench has been excavated to fit the invert of the sewer, with the exception of about 1,000 feet beginning on Central Square and running southerly on Border Street to about 300 feet south of Decatur. Where excavated to fit the invert, the bottom of the trench has been of clay sufficiently hard to shape out. It was not as a rule shaped to closely fit the pipe, and sand and fine gravel were filled in to the height of the top of the pipe, to insure an even bearing.

For a distance of 33 feet in Central Square it was necessary to excavate below the bottom of the pipe and refill with about 16 inches of gravel.

Difficulties. — An old sea wall near Decatur Street let the tide into the trench and caused considerable trouble. The tide was finally cut off with concrete and clay dams sufficiently to allow the work to go on.

Miscellaneous. — To avoid a man-hole of the New England Telephone and Telegraph Company, the line at the corner of Central Square and Border Street was changed. A slight change was also made at the corner of Maverick and New streets, for convenience in sinking tunnel shafts.

SECTION 39 (WORK ABANDONED BY CONTRACTOR), EAST BOSTON.

Location. — From the intersection of Porter and Bremen streets, through Porter Street to Central Square.

Length of section (18-inch pipe sewer),	1,752* feet.

Assistants.

Assistant Engineer: Seth Peterson.
Foreman: Michael Tallent.
Transitmen: Principals — E. S. Foster, George F. Chase.
Assistants — H. L. Morrow, W. G. Crispin, Burton A. Clark.
Time-keeper: Harry L. Ward.

Length of trench excavated to grade,	1,308.0 feet.
Length of tunnel excavated to grade,	406.0 "
Average depth of trench to bottom gravel refilling,	20.0 "
Greatest depth of trench to bottom gravel refilling,	22.5 "
Average width, top of trench,	5.0 "
Average width, bottom of trench,	4.0 "
Average depth from surface to bottom of tunnel excavation,	18.5 "
Greatest depth from surface to bottom of tunnel excavation,	21.0 "
Average width, tunnel,	3.5 "
Volume of trench excavation per linear foot,	3.3 cu. yds.
Volume of tunnel excavation per linear foot,	0.6 " "

Character of Earth Excavation. — Section at Bremen Street: gravel filling 6 feet, ashes 2 feet, peat 4 feet, coarse sand 2 feet, fine sand to grade; practically same formation continues to a point about midway between London Street and Central Square, where filling 6 feet, peat 4 feet, then mixture of clay and gravel to grade was encountered; at a point about in front of Central building, where the excavation was carried on in tunnel, the clay and gravel changed to peat in the roof with sand below; the peat gradually worked down, until at the end of the section in front of the Maverick Church it was about 2 feet below water line, while the sand gave way to clay beneath.

Approximate cost of masonry per man-hole (including iron work), $92.

Underdrain, 8-inch,	887 feet.
Underdrain, 6-inch,	329 "

Began laying pipe Oct. 10, 1894; finished March 29, 1895.
Approximate cost of whole section, including inspection and miscellaneous items (per linear foot), $13.50.

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* This includes 38 feet built by contractor.

Excavation.

	Opening No. 1.	Opening No. 2.	Opening No. 3.	Opening No. 4.
Character of opening,	Open cut,	Tunnel,	Tunnel,	Tunnel.
Number of tunnel headings,	–	Two,	Two,	Two.
Date of starting,	Continued,	Jan. 31, 1895,	Feb. 11, 1895,	Feb. 14, 1895.
Point of beginning, or point of continuing from last year's work.	Chelsea Street,	Corner Porter Street and Central Square.	Opposite Central building.	Opposite Maverick Church.
Point or points of ending,	Bremen Street and Porter Street, east of Central Square.	Porter Street, 54 feet east of Central Square, 80 feet south of shaft.	10 feet north of shaft, 64 feet south of shaft.	100 feet north of shaft, 98 feet south of shaft
Date of finishing,	Jan. 31, 1894,	Feb. 16, 1895,	March 8, 1895,	March 29, 1895.
Extent,	1,308 feet,	134 feet,	74 feet,	198 feet.
Ordinary progress per week,	90 feet,	60 feet,	30 feet,	33 feet.
Appliances used,	Trench machine,	Incline,	Incline,	Incline.
Size of gang ordinarily employed,	38 men,	16 men,	16 men,	16 men.

A 6-inch centrifugal pump, located at Chelsea Street, took care of the ground water for the entire length of the open cut. A 2-inch Worthington pump was placed in the shaft at the corner of Porter Street and Central Square. A 2-inch Davis pump was used for a short time in the shaft opposite the Maverick Church. The estimated amount of water pumped per twenty-four hours was 750,000 gallons.

Fine wet sand was encountered from the beginning of the section to a point about half-way between London Street and Central Square. Between these points the trench was excavated to a depth of from 1½ to 2 feet below grade, the underdrain laid, and the joints wound with cloth to prevent the entrance of sand into the pipe. The underdrain was then surrounded with coarse gravel, after which the trench was refilled to the top of the sewer with bank gravel.

In the tunnel, where the bottom was of clay and gravel or gravel, the pipe was laid directly on this, except that sufficient fine material was placed around the pipe to give an even bearing.

With the exception of the fine wet sand, the only other difficulty encountered was with gas in the tunnel headings at Central Square, the men being able to work but a few hours at a time before their eyes became affected. A blower was finally placed at the shaft, which forced a sufficient supply of fresh air into the tunnel to enable them to work without great annoyance.

Accidents. — On Jan. 27, 1895, Lizzie Murphy, residing at 24 Havre Street, East Boston, received injuries to her head and spine by falling into the trench at the intersection of Porter and London streets, while attempting to cross on a fend log.

On the afternoon of June 21, 1895, an engineering party was inspecting the city sewer on Porter Street, when the whole party was overcome by sewer gas. One of them, Mr. Harry L. Ward, was sent to the Massachusetts General Hospital, where he died at 7 o'clock that evening. He was a young man of promise, and his loss was sadly regretted. This is the first death in the engineering corps since the commencement of the work.

The house No. 9 Porter Street was slightly settled by movement toward the trench. The city sewer in Porter Street was also slightly cracked in the key from Bremen Street to Havre Street.

SECTION 43½ (DAY WORK), MYSTIC RIVER SIPHON, ALEWIFE BROOK LINE.

Location. — Under and on either side of the Mystic River, Medford and Somerville, about 50 feet easterly from the Boston-avenue bridge (see page 116, sixth annual report).

Character of Structures. — The structures on the southerly side of the river consist of a sand-catcher of brick and concrete masonry, about 6 feet by 7 feet and 25 feet 6 inches long. The sand-catcher has gate-chambers at its outlets and an overflow of 24-inch Akron pipe, extending into the river. The overflow pipe terminates with a 24-inch iron pipe, and the outlet is protected by a pier of stone masonry The sand-catcher connects with an inverted siphon which extends under the river. The man-holes at the ends of the siphon are constructed of brick and concrete masonry, and are connected under the river bed by about 86 linear feet of 24-inch Akron pipe, surrounded by 16 inches of Portland cement concrete. The siphon connects on the northerly side of the river, by a gate-chamber, with the sewer already built.

Assistants.

Assistant Engineer: Guy C. Emerson.
Transitman: Harry L. Ward.
Foreman: Paul Hill.

Method of Construction. — The work was done by means of a coffer-dam. Round piles, in bents about 10 feet apart, were driven across the river, forming a bridge and support for the coffer-dam. A coffer-dam of 6-inch sheeting, with its top about 3 feet above high water, was commenced from the northerly side of the river. This coffer-dam was 14 feet wide at the river wall and increased to 18 feet on the southerly side of the river, the extra width being necessary to accommodate the overflow pipe and necessary structures on the southerly side. The sheet-piling for coffer-dam was driven about 11 feet below the bed of the river, by means of a pile-driver, into soft blue clay containing bowlders. The coffer-dam was built in two sections. By this method about half the width of the river was allowed to remain unobstructed at all times. The sheeting for the excavation on each bank was of 2-inch planks driven by hand.

After the coffer-dam had been pumped dry, a trench, 5 feet wide and of an average depth of about 6 feet, was excavated inside of it, in which the 24-inch pipe and concrete masonry of the siphon were laid.

The coffer-dam on the northerly side of the river was kept dry by a 6-inch Blake pump, which was operated about half the time.

On account of the amount of sand in the water pumped, a 6-inch centrifugal pump was used on the southerly side. The pump was operated very slowly and not more than one-fourth of the time. The average depth of water in the river at high tide was about 10 feet.

Character of Excavation. — On the northerly side of the river peat was encountered, which was excavated to an average depth of about 8 feet below sewer grade, and the space filled with concrete. Under the river the material consisted of about 2 feet of gravel, underlaid by soft blue clay, containing large bowlders. For the structures on the southerly side a pile foundation was used on account of peat.

River Wall. — The river wall found on the northerly side of the river was built of loose rubble. This was relaid in cement mortar.

Cost. — The total cost of the above-described work was approximately $8,072.97.

ALEWIFE BROOK PUMPING STATION AND CONNECTIONS, NORTH SOMERVILLE.

Location. — On the easterly side of Alewife Brook, about 350 feet from the Mystic pumping station of the Boston water works.*

Length of section (about), ... 200 feet.

Day Work.

Structures. — The work consists of foundation walls and floors of building, containing engine-room 22 feet by 31 feet; boiler-room 16 feet by 30 feet; 46 feet of low-level sewer, 2 feet 11 inches by 3 feet 6 inches; screen man-hole with valve, etc.; supply-well for condensers; 24-feet suction-conduit 3 feet by 5 feet 6 inches; 4 wells 4 feet 4 inches by 4 feet 8 inches; and 108 feet high-level sewer 3 feet by 3 feet 7 inches.

Assistants.

Architect: E. N. Boyden.
Assistant Engineer: Seth Peterson.
Foreman: Michael Tallent.
Transitmen: Principal — T. T. Cass.
    Assistant and Inspector — Burton A. Clark.
    Assistants — W. G. Crispin, O. F. Barnes.

Building Foundations. — The excavation was through peat and ashes to a depth of from 5 to 7 feet to a foundation of solid clay. Upon this the footing courses of stone were laid, except for the south wall, which is located directly over the suction-conduit. For this a pier of concrete was built up from the arch of the sewer. The footing courses are of granite, the stones being about 3½ feet long, laid crosswise of the wall, and varying in thickness from 1 foot to 1 foot 8 inches. Upon these footings a bluestone wall, 2 feet 4 inches thick at the bottom and 1 foot 8 inches thick at the top, was built. The elevation of the top of the foundation is 117.08 in the front and 113.08 in the rear.

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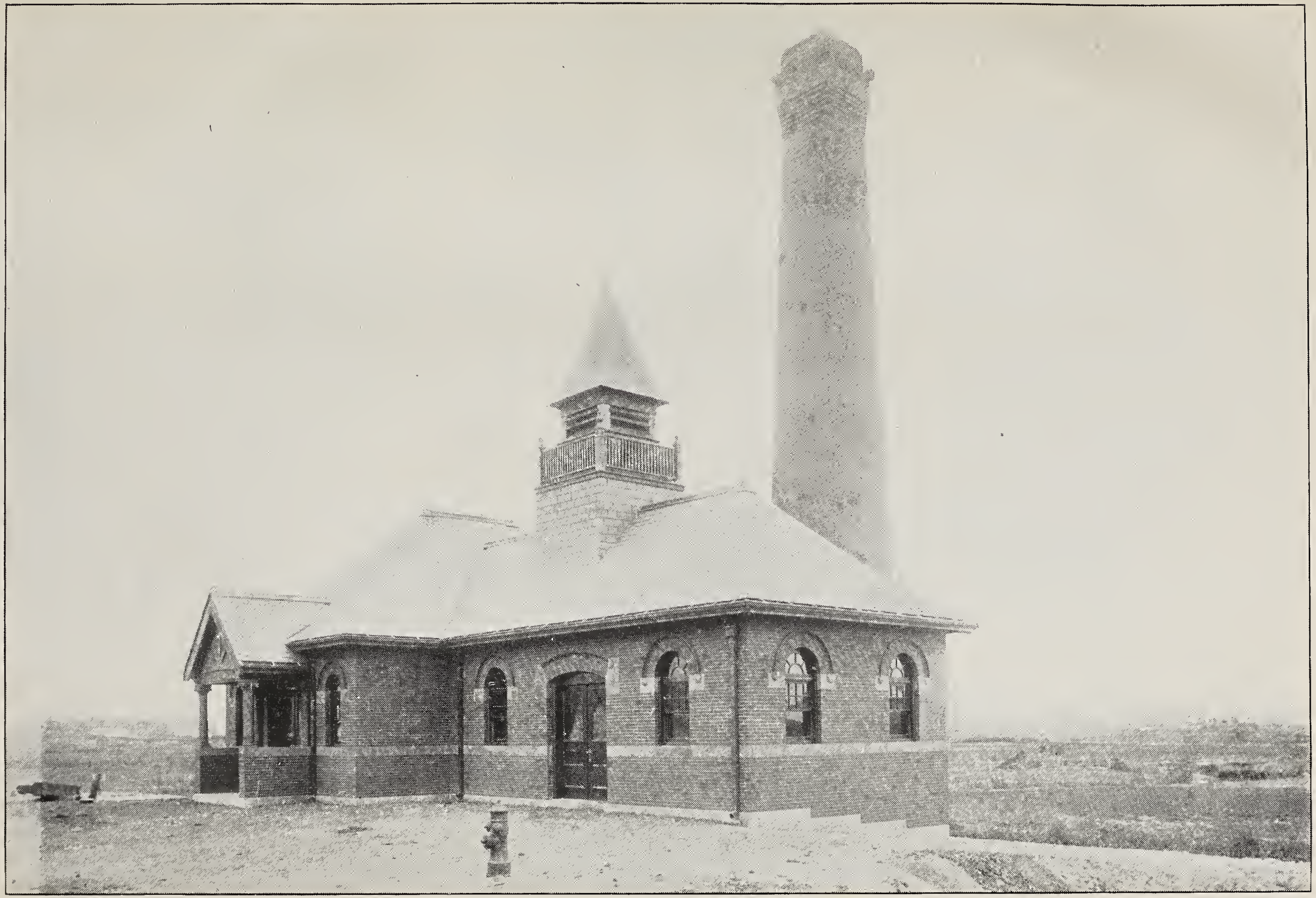
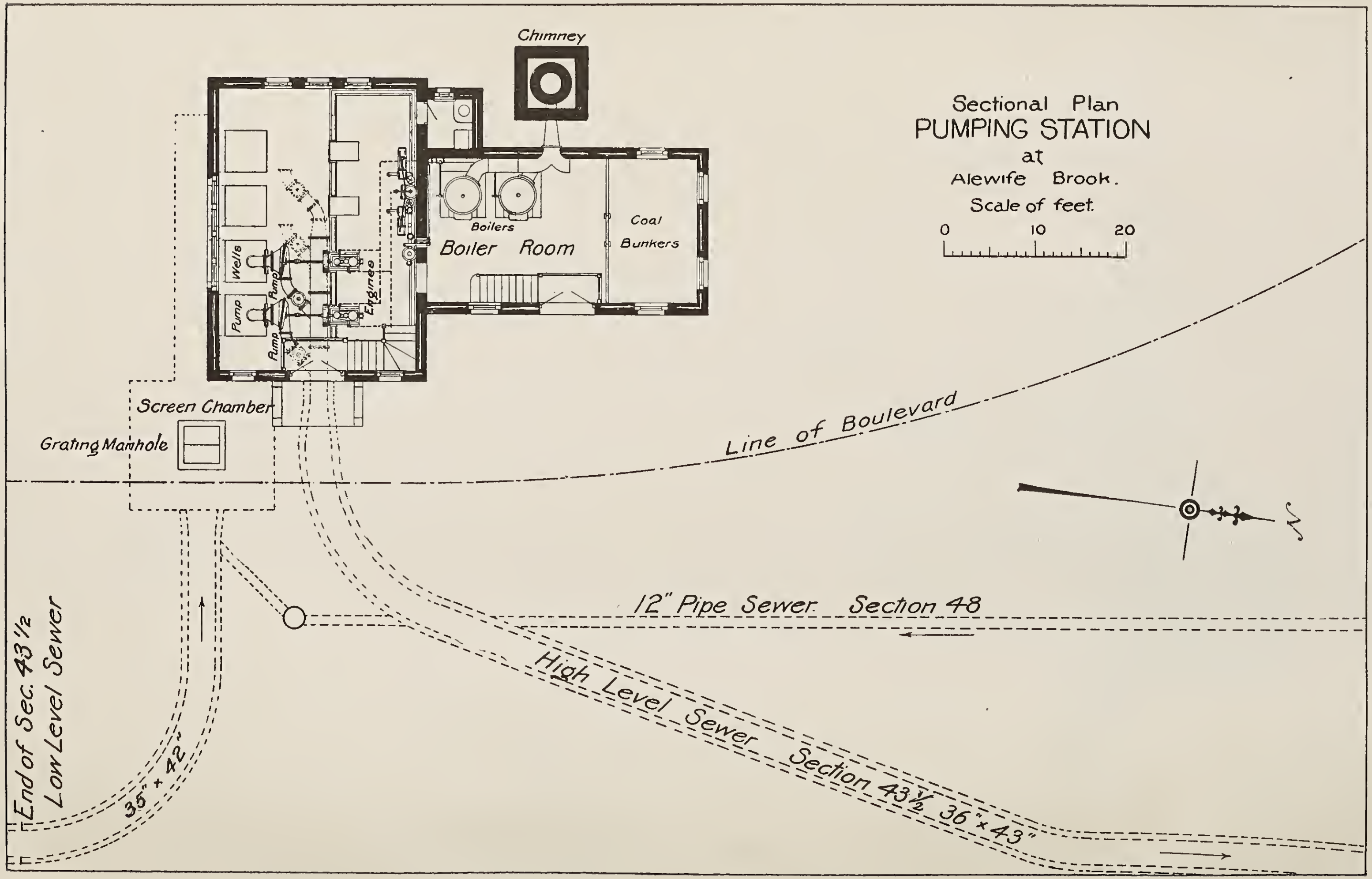
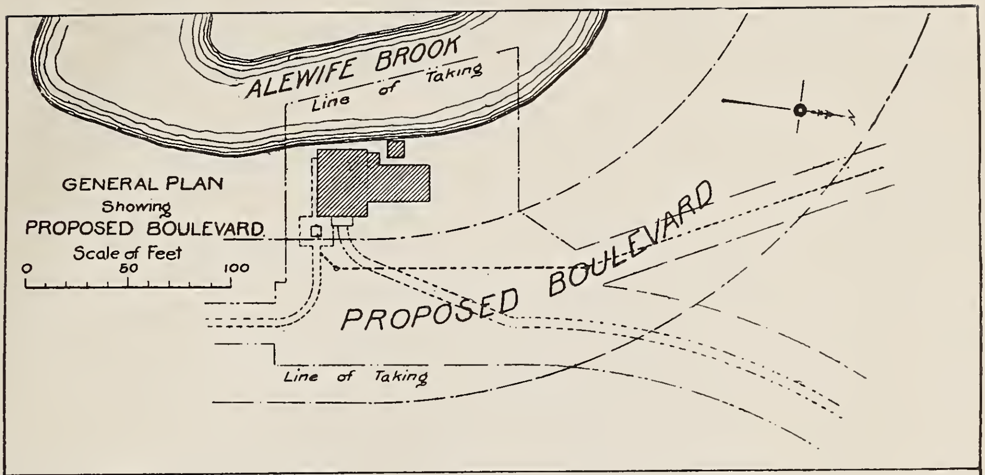
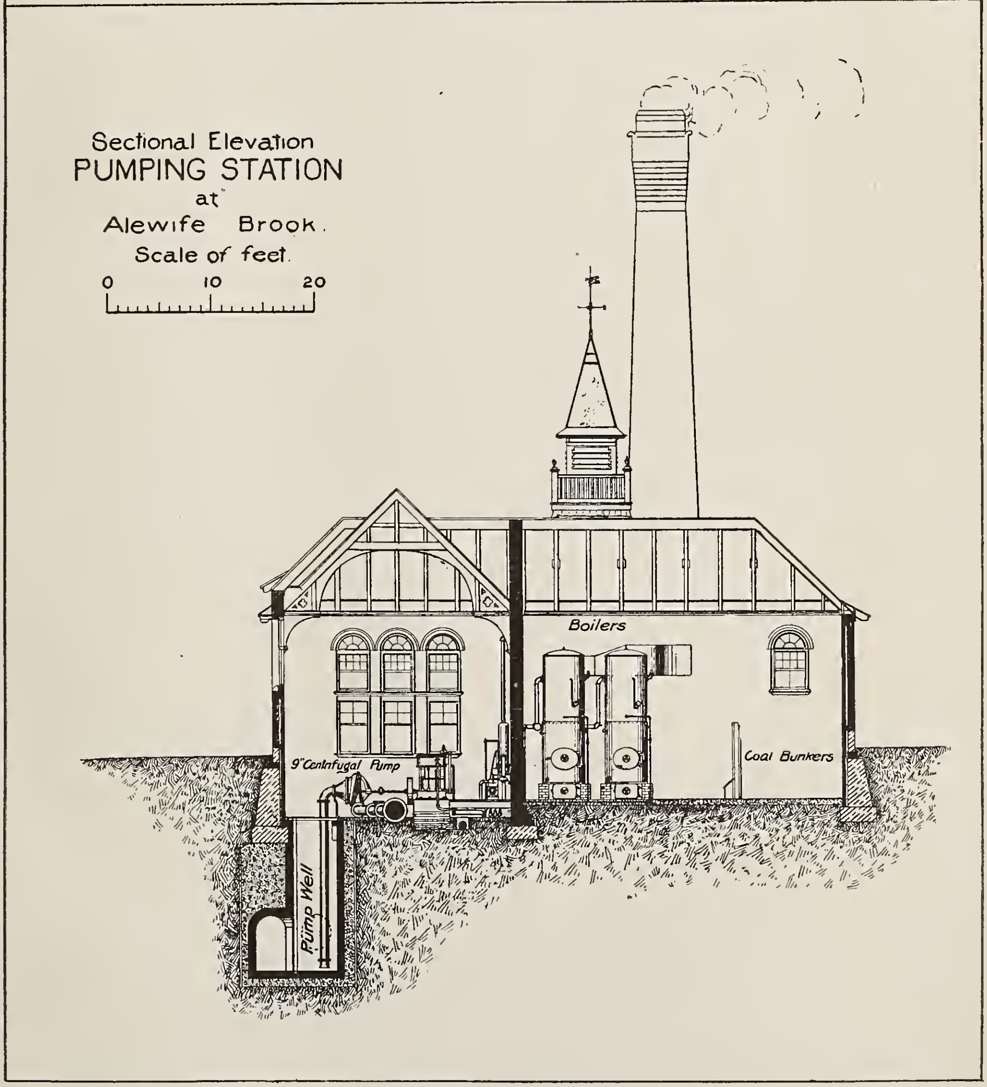
* At the time the contracts were made for sections 43 and 43½, it had been planned to locate the pumping station about 70 feet east of its present location, but during the time which had elapsed between the construction of these sections and the commencement of work on the pumping station a boulevard had been projected which passed through the proposed pumping station site. To avoid this, the pumping station was moved about 70 feet west. This increased the length of the low- and high-level sewers, and added somewhat to the cost of the station.



ALEWIFE BROOK PUMPING STATION, NORTH SOMERVILLE.


Sectional Plan
PUMPING STATION
at
Alewife Brook.
Scale of feet.
0
10
20
Chimney
Boilers
Boiler Room
Coal Bunkers
Wells
Pump
Pump
Pump
Engines
Screen Chamber
Grating Manhole
Line of Boulevard
12" Pipe Sewer Section 48
High Level Sewer Section 43½ 36"×43"
End of Sec. 43½ Low Level Sewer
35"×42"
N


ALEWIFE BROOK
Line of Taking
GENERAL PLAN
Showing
PROPOSED BOULEVARD.
Scale of Feet
0
50
100
PROPOSED BOULEVARD
Line of Taking


Sectional Elevation
PUMPING STATION
at
Alewife Brook.
Scale of feet.
0
10
20
Boilers
9" Centrifugal Pump
Coal Bunkers
Pump Well

Chimney Foundation. — The base is 11 feet square, of granite 4 feet deep, laid on 2 feet of Portland concrete resting on solid clay. Work was begun on the foundations May 1 and completed June 20, 1895.

Low-level Sewer, Suction-conduit, Wells, etc.

Excavation :

Average depth,	16.0 feet.
Average width, sewer,	5.8 "
Average width, conduit and wells,	12.0 "

The material excavated was ashes and peat to a depth of about 5 feet; then clay and disintegrated rock to grade.

The bottom of the pump-well was of rock, and upon this a 4-foot circular man-hole was built, which is designed to be used as a well to furnish water for the condenser pumps.

The screen man-hole is 11 feet by 13 feet, and at the upper side a valve is placed, by means of which the sewage can be shut off from the wells in case of accident to the pumps.

High-level Sewer.

Excavation :

Average depth,	3 feet.
Average width,	6½ "

The excavation was in ashes and peat, which was thrown out by hand. The masonry is all laid in Portland cement. An embankment, which also forms a road to the pumping station, was built over the sewer.

Cost. — Total cost of foundations and connections, including labor, materials, tools, etc ,	$8,443 33

Contract Work.

State Assistants.

Architect : E. N. Boyden.
Inspector : James E. Coyne.

Contractor.

Contractor for Station. — William T. Eaton of Boston.
Contractor's Foreman. — M. E. Flynn.

Building. — The station is of brick and stone, with engine-room 22 by 31 feet and boiler-room 16 feet by 30 feet. The height of walls is 15 feet above foundations in front and 19 feet in rear. The chimney is 60 feet high.

Pumping Plant. — This consists of two upright 48-inch tubular boilers, rated at 25 horse-power each; two engines of the marine type, compound condensing, cylinders 5 and 10 inches, 7-inch stroke, rated at 25 horse-power each; and two 9-inch Andrews centrifugal pumps.

The boilers were made by the James Russell Boiler Works Company of Boston, Mass., at a contract price of $1,135.

The engines were made by the Fore River Engine Company of Weymouth, Mass., at a contract price of $1,500.

The pumps were furnished by Joseph Edwards & Co. of New York, at a cost of $1,100.

SECTION 47, WINCHESTER AND WOBURN.

At the date of the sixth annual report the excavation on this section was completed. There remained 233 feet of pipe to be laid. The work was completed about November 1. The amount of the final estimate was $9,128.22. Contractors: Lindsay & Cudmore.

SECTION 48 (DAY WORK), SOMERVILLE, ARLINGTON AND MEDFORD.

Location. — This section consists of 3 short lines of pipe sewer: one starting at a point on Section 43½, about 500 feet south of Mystic pumping station, and running in a westerly direction to a point about 40 feet beyond Alewife Brook into Arlington; another line runs from a point about 300 feet south of Mystic pumping station, in a north-westerly direction, across the Mystic River to the centre of Jerome Street, Medford, at a point about 100 feet west of the bridge; the third line extends along Boston Avenue from a point opposite the entrance to Mystic pumping station to the line of division between Somerville and Medford.

Diameters of sewers and length of each size: —

Decatur Street, 18 inches, ...	456 feet.
Jerome Street, 12 inches, ...	553 "
Boston Avenue, 10 inches, ...	578 "

Assistants.

Assistant Engineer: Seth Peterson.
Inspector: Burton A. Clark.
Transitmen: Principal — T. T. Cass.
Assistants — W. G. Crispin, O. F. Barnes.
Foremen: Michael Tallent, William Ryan.

Trench.

	18-inch.	12-inch.	10-inch.
Length of trench completed (feet), ...	456.0	553.0	578.0
Average depth of trench excavation to bottom of under-drain (feet), ...	12.0	13.6	9.0
Greatest depth of trench excavation to bottom of under-drain (feet), ...	17.7	15.0	10.1
Average width, top of trench (feet), ...	4.8	4.2	2.5
Average width, bottom of trench (feet), ...	4.7	3.2	2.3
Volume of trench excavation per linear foot (cubic yards), ...	2.0	2.9	.8

Approximate cost of masonry in 12 man-holes, each $58.50.

Approximate cost of section per linear foot of excavation, pipe, masonry in man-holes, including labor, material, superintendence, inspection and miscellaneous items, $6.05.

Character of Earth Excavation. — Eighteen-inch branch: peat and silt to about 6 feet below surface, then clay to grade; 12-inch branch: 6 inches of loam, then 2 feet ashes, gravelly clay to grade, until the river was reached, when the clay became mixed with sand with a tendency to boil and run; 10-inch branch: on Boston Avenue, sand, gravel and disintegrated rock.

A Carson trench machine was used in excavating, except at Boston Avenue, where the material was thrown out by hand. On the Decatur- and Jerome-street branches a pulsometer was used in a pump-well at each, and a hand pump in the trench where necessary. On Boston Avenue no pumping was required.

Foundation. — The whole Decatur-street line (18-inch), about 300 feet on the Jerome-street line (12-inch), and all of the Boston-avenue line (10-inch) were excavated nearly to the shape of the pipe, and enough fine gravel placed under and around the pipe to fill any uneven places caused by removal of stones, etc. For about 250 feet on the Jerome-street line (12-inch), under and near the river, it was found necessary to excavate about 8 inches below grade and refill with gravel.

Difficulties. — In crossing Alewife Brook and Mystic River coffer-dams were used. A row of piles was driven on each side of the trench, about 6 feet from the centre line and 12 feet apart. To these were bolted 8 by 8 inch spruce rangers, against which tongued and grooved sheeting was set. The sheeting was driven by hand into the river bottom as far as possible. Inside this sheeting, and about 4 feet from it, was another set of sheeting braced like an ordinary trench, and the space between the two sets filled with bank gravel. The trench was in this manner kept comparatively dry. It was flooded once or twice, however, for one tide while bulkheads were being shifted.

Precautions. — Under Alewife Brook the pipe was surrounded by 6 inches of Portland concrete. Under the Mystic River the pipe was laid on 6 inches of Portland concrete, and was surrounded on sides and top by about 1 foot of Portland concrete.

Miscellaneous. — A slight change in the line of the branch running to Jerome Street was made to avoid the engine-house of the temporary pumping plant. Under the river the top of the concrete is at elevation of river bottom. The surplus earth has been used in grading about the pumping station.

CEMENT TESTING.

Approximately 11,000 barrels of Portland cement and 5,000 barrels of American cement have been used during the year, and 5,000 tests of cement have been made. The cement has been tested for fineness through sieves of 2,500, 10,000, 14,400, 22,500 and 32,400 meshes to the square inch.

The tests have been made with hot and cold water, steam and salt and fresh water. Tests have also been made of different qualities of sand, crushed granite and quartz.

Screened Plum Island sand has generally been used in testing.

TABLE OF PROGRESS.

The following table recapitulates to some extent the detailed information given in the foregoing pages and in reports of preceding years. The Charles River Valley sections are designated by letters and those of the North Metropolitan district by numbers: —

TABLE OF SEWER WORK COMPLETED AND IN PROGRESS SEPT. 30, 1895.

Section.	Locality.	Name of Contractor.	Total Length of Section. Feet.	Size of Sewer.	Average Depth of Trench, Bottom of Underdrain or Deeper Excavation. Feet.	Length of Sewer completed Sept. 30, 1895. Feet.	Date of Completion named in Contract.
O	Boston,	Built by city of Boston,	1,897	6' 6",	23	1,897	May, 1890
A	Boston,	H. C. Eyre,	3,701	5' 6",	20.3	3,701	Aug. 31, 1891
B	Boston and Brookline,	H. C. Eyre,	2,962	5' 6',	18.5	2,962	Feb. 28, 1891
C	Brighton,	National Construction Co.,	5,787	4' 10",	16.4	5,787	Aug. 31, 1891
D	Brighton,	National Construction Co.,	5,300	4' 10'×5' 3",	17.2	5,300	July 31, 1891
E	Brighton,	Jones & Meehan,	8,027	4' 6"×5' 1",	14.7	8 027	Nov. 30, 1891
F	Newton and Watertown,	Jones & Meehan,	7,675	4' 2"×4' 9", 3' 11"×4' 5",	10.4	7,675	Nov. 30, 1891
G	Newton,	Jones & Meehan,	2,800	3' 11"×4' 5", 3' 6"×4',	19.1	2,800	Nov. 30, 1891
H	Newton,	Metropolitan Construction Co.,	4,497	3' 6"×4',	13.7	4,497	Nov. 30, 1891
1	Deer Island,	Day work,	1,931	6' 3",	14	1,931	-
2	Deer Island,	National Construction Co.,	2,120	Outfall sewer, 6'×6' to 6'×10', Main sewer, 9',	17 28	2,120	Feb. 29, 1892
3	Deer Island,	R. A. Malone & Co.,	2,641	9',	26	2,641	April 30, 1891
3½	Deer Island and Winthrop,	Day work,	430	Main sewers, 9', 6' 4", Sand-catcher, 16'×16', Siphon, 6' 2",	21 23 13	138 28 264	-
4	Winthrop,	Metropolitan Construction Co.,	5,710	9',	22	5,710	June 30, 1891

TABLE OF SEWER WORK COMPLETED, ETC. — *Continued.*

Section.	Locality.	Name of Contractor.	Total Length of Section. Feet.	Size of Sewer.	Average Depth of Trench, Bottom of Underdrain or Deeper Excavation. Feet.	Length of Sewer completed Sept. 30, 1895. Feet.	Date of Completion named in Contract.
5	Winthrop,	Metropolitan Construction Co.,	4,600	9',	16	4,600	July 31, 1891
6	Winthrop,	Metropolitan Construction Co.,	4,113	9',	18	4,113	May 31, 1891
7	Winthrop and East Boston,	Trumbull & Ryan,	848	Main sewer, 8' 6"×9' 2", Sand-catcher, 16'×16' 5", and siphon approaches, Siphon (3 parallel lines), 5',	6.5 11.4 13.6	848	June 1, 1893
8	Breed's Island,	Charles Linehan,	4,126	9',	16.4	4,126	Aug. 31, 1891
9	East Boston and Chelsea,	Charles Linehan,	3,383	9',	15.8	3,383	May 31, 1891
10	East Boston and Chelsea,	Day work,	709	Siphon, 5' 8", Sand-catcher, 15' 5"×16' 1",	53* 23†	709	-
11	Chelsea,	Charles Linehan,	3,034	2' 1"×2' 10",	17.0	3,034	Sept. 30, 1894
12	Chelsea,	Orin P. Roberts,	3,034	8' 4"×9',	27.0	3,034	April 30, 1893
14	Chelsea,	Metropolitan Construction Co.,	3,445	8' 10", 8' 4"×9', 8' 2"×8' 10",	28.60* 37.0†	3,445	Dec. 30, 1893
15	Chelsea,	Christy McBride,	1,754	8' 2"×8' 10",	23.2	1,754	May 31, 1892
16	Everett,	R. A. Malone & Son,	4,431	8' 2"×8' 10", 5' 10"×6' 4",	21.1 20.7	4,431	Nov. 30, 1892
17	Everett,	Christy McBride,	3,528	5' 10"×6' 4", 4' 8"×5' 1",	21.4	3,528	Sept. 30, 1892
17½	Everett,	Metropolitan Construction Co.,	1,627	4' 8"×5' 1",	17.0	1,627	Sept. 30, 1892

19	Everett and Medford,	Day work,	496	Sand catcher, 10'×11' 3", 4' 8"×5' 1", 3' 6", 3' 6", 4' 8"×6' 2", 3' 6",	13.0 12.7	267 229	- -
20	Medford,	John Sheehan,	9,170	Main line, 4' 8"×5' 1", 4' 5"×4' 8", Edgeworth branch, 2',	18.5 13.3	9,170	April 30, 1893
21	Medford,	National Construction Co.,	8,030	4' 5"×4' 8", 4' 3"×4' 6",	14.0	8,030	Feb. 28, 1893
21	Medford (Gravelly Brook culvert),	Sub-contractors: Wm. H. Lenox & Co., A. W. Bryne,	54	4' 5"×4' 8",	12.8	54	-
21	Medford (Winthrop Street culvert),	Day work,	181	4' 3"×4' 6",	6.5	181	-
22	West Medford,	Andrew W. Bryne,	6,033	3' 4"×3' 6",	23.0* 28.0†	5,347 686	June 30, 1893
23	Everett,	R. A. Malone & Sons,	2,268	6'×6' 8",	25.3	2,268	June 30, 1892
24	Everett and Charlestown,	Metropolitan Construction Co.,	2,332	6'×6' 8",	25.0	2,332	Sept. 30, 1892
25	Charlestown,	Day work,	1,540	Main sewer, 6'×6' 8", 6'×7' 1", Siphon, 5',	23.1* 44.0†	1,540	-
25½	Charlestown,	Day work,	585	6' 7"×7' 5", 6' 5"×7' 2",	27.3	585	-
25½	Arlington Avenue connection,	Day work,	61	40"×49",	-	61	-
26	Charlestown and Somerville,	Harry P. Nawn,	3,750	6' 5"×7' 2", 5' 9"×6' 6",	34.3† 23.5* 28.8†	3,750	Nov. 30, 1893
26‡ 27‡	Somerville,	Day work,	950	5' 9"×6' 6",	35.0†	950	-
27	Somerville and Cambridge,	McGovern & Kitch, Metropolitan Construction Co., Day work,	4,326	5' 9"×6' 6", 5' 2"×5' 9",	24.4* 22.9* 25.5†	4,326	Aug. 31, 1893
28	Cambridge,	John L. Reardon & Co.,	6,503	4'×4' 6",	19.2* 23.0†	*6,424 †79	April 30, 1894

* Trench. † Tunnel. ‡ Part of.

TABLE OF SEWER WORK COMPLETED, ETC. — *Concluded.*

Section.	Locality.	Name of Contractor.	Total Length of Section. Feet.	Size of Sewer.	Average Depth of Trench, Bottom of Underdrain or Deeper Excavation. Feet.	Length of Sewer completed Sept. 30, 1895. Feet.	Date of Completion named in Contract.
29	Cambridge,	Lindsay & Cudmore,	5,157	4'×4' 6", 3' 8"×4' 2", 3' 6"×4',	16.2 12.9 18.0	5,157	Nov. 30, 1893
30	Cambridge,	Jones & Meehan,	7,032	3' 5"×3' 8", 2' 10"×3', 2' 8"×2' 10, 2' 3"×2' 4",	13.8 15.6 12.7	7,032	April 30, 1894
31	Charlestown,	Metropolitan Construction Co.,	4,509	2' 5'×3' 1", 3' 1"×3' 8", 2' 7"×3' 3", 1' 3",	27.4* 31.8† 23.7 –	4,509 –	Nov. 30, 1894
32	Charlestown,	Metropolitan Construction Co.,	4,705	2' 7"×3' 3", 2' 5"×3' 1", 2' 3"×3', 2' 1"×2' 10". 1' 7"×2' 4".	29.5 19.0 16.8 –	869 2,214 678 944	Nov. 30, 1894
32	Charlestown Navy Yard,	Day work,	1,572	2' 1"×2' 10", 1' 10"×2' 7", 1' 7"×2' 4",	19.2* 16.8† –	992 580 –	–
35	Charlestown, Somerville and Medford,	James Heath & Son,	8,371	3' 4"×4' 1", 3' 3"×3' 11", 2' 11"×3' 7", 1' 10"×2' 3",	29.0* 29.0† 21.7	*214 †3,872 *3,709 †54	Nov. 30, 1894
36	East Boston,	National Construction Co.,	237	1' 3" vitrified pipe,	18.5	237	Sept. 30, 1894
37	East Boston,	John Sheehan,	4,882	3' 4"×3' 9", 3'×3' 5",	30.0 26.5* 31.0†	*2,144 †2,738	June 30, 1894

37½	East Boston,	Day work,	276	3' 5"×3' 10 ,	28.0†	276	-
38	East Boston,	James Heath & Son,	8,229	3'×3' 5", 2', 1' 6", 1' 3", 1',	24 21 20 18	8,229	Nov. 15, 1894
39	East Boston,	Metropolitan Construction Co.,	6,944	1' 6", 1' 3," 1',	21 14.5	6,944	Oct. 30, 1894
40	Everett and Malden,	R. A. Malone & Sons,	6,252	3' 9"×4' 1",	16.0	6,252	Aug. 31, 1892
41	Malden and Melrose,	Moulton & O'Mahoney,	9,793	2' 1"×3' 2", 1' 10"×2' 9", 1' 8"×2' 6",	13.0	9,793	Sept. 29, 1893
41	Malden,	Day work,	1,014	2' 1"×3' 2", 1' 8"×2' 6",	10.0	1,014	-
42	Melrose and Stoneham,	David L Clements,	3,050	1' pipe,	11.4	3,050	Nov. 30, 1892
43	Somerville and Cambridge,	Metropolitan Construction Co.,	14,450	2' 11"×3' 6", 2' 5"×3' 1", 2' 3"×2' 11", 1' 11"×2' 9", 1' 6" pipe, 1' 3" pipe,	20.0* 26.0† 10.5* 16.0† 7.0 7.0	14,450	Oct. 31, 1893
43½	Medford and Somerville,	Metropolitan Construction Co.,	2,312	3'×3' 7", 2' 11"×3' 6",	13.1	2,312	Aug. 31, 1893
43½	Siphon, Mystic River,	Day work,	150	6'×7' sand-catcher, 2' pipe siphon,	-	150	-
44	Winchester,	Jones & Meehan,	5,608	2' 7"×2' 11", 2' 3' ×2' 6", 2'×2' 5",	13.6* 20.0†	*5,354 †254	Nov. 30, 1893
44½	West Medford and Winchester,	Weaving, Booth & Co.,	5,605	2' 11"×3' 3", 2' 9"×3' 1",	12.0	5,605	Mar. 31, 1894
44½	Siphon, Abbajona River,	Abandoned contract work,	80	6'×14' sand-catcher, 1' 8" pipe siphon,	4.0	80	-
45	Winchester,	Everson & Liddle,	6,508	2'×2' 5", 1' 10"×2' 3",	9.6	6,508	Sept. 30, 1893
46	Winchester, Woburn and Stoneham,	Charles Linehan,	5,757	1' 10"×2' 3", 1' 6"×2', 1' 3" pipe,	10.0 8.7* 21.0†	5,757	Aug. 31, 1893
47	Winchester and Woburn,	Lindsey & Cudmore,	4,510	1' 8", 1' 6", 1' 3" pipe,	8.0	4,510	Aug. 31, 1894
48	Somerville, Arlington and Medford,	Day work,	1,587	Decatur Street, 10" pipe, Jerome Street, 12" pipe, Boston Avenue, 10" pipe,	- - -	456 553 578	-

* Trench.

† Tunnel.

Where work on the same section has continued through two or more years some statistics and other statements contained in former reports have been repeated in succeeding ones for convenience of reference. This is desirable, among other reasons, on account of the great scarcity of former reports.

The foregoing detailed reports of sections are in general condensed from those of the various assistant engineers directly connected with the work.

OFFICE ASSISTANTS.

In addition to the assistant engineers and other assistants above referred to, the following office assistants have been employed for the whole and parts of the year: —

Assistant Engineers: —
  Charles H. Swan,* special hydraulic studies and calculations.
  Winslow Blanchard,* mechanical studies and equipment of pumping stations.
Assistant Engineer and Purchasing Clerk. — Alfred F. Bridgman.†
Purchasing Clerk and Plan-keeper. — Charles E. Hathaway.†
Draughtsmen: —
  Alfred N. Wahlberg.†
  William J. Watkins.
  Henry Cleary.
  Frank A. Emery.
  Arthur H. Pratt.
  Harry C. Dove.†
Stenographers: —
  Arthur B. Carter.†
  Henry P. Fielding.†
Assistant Stenographer. — Frank E. Bridgman.†
Clerks: —
  William Gray.
  Burton W. Torrey.
Plan-keeper. — Harry L. Morrow.†
Cement Tester. — Nelson A. Hallett.*
Photographer. — George P. Goodman.*
Messenger. — Madison C. Lewis.

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* Engaged for a portion of his time only by the Metropolitan Sewerage Commission.
† For a portion of the year.

MAINTENANCE.

Early in April the work at the pumping stations was sufficiently advanced to warrant clearing the main sewer of bulkheads, and preparing to receive sewage from the tributary cities and towns. The Edward P. Allis Company of Milwaukee, contractors for the steam and pumping plants at Deer Island, East Boston and Charlestown, were not prepared at that date to go on with the formal duty trials of the pumping machinery contemplated under the contracts. Informal capacity tests at Deer Island and East Boston yielded favorable results, and satisfactory arrangements were made with the contractors for the use of the pumps prior to final test and acceptance.

For maintaining and cleaning the main sewer and branch lines a force was organized consisting of a foreman, assistant foreman and fifteen men, with the necessary complement of horses and teams. For convenience the whole system was grouped into five divisions, and three men allotted to each division, as follows: —

Division 1. — From the outlet at Deer Island to the pumping station at East Boston and the East Boston branches.

Division 2. — From the East Boston pumping station to the junction of Canal and Prescott streets, Medford; the Cambridge branch as far as the Charlestown pumping station; and the Malden and Melrose branch.

Division 3. — The main line from junction of Canal and Prescott streets, Medford, to Stoneham; the Alewife Brook branch; and the Mystic Valley Sewer, acquired from the city of Boston, from its outlet at Lower Mystic Lake to the Woburn line.

Division 4. — The Cambridge branch above the Charlestown pumping station, and the Charlestown and Somerville branches.

Division 5. — The Charles River System from Gainsborough Street, Boston, to Waltham (in operation since May 1, 1892).

During the months of April and May this maintenance force was engaged in pumping from the sewers the accumulated ground water and removing bulkheads. An effort was made to determine approximately the rate of infiltration of ground waters into the system. The leakage from sections of the main sewer and branches, usually between city or town lines, was pumped for twelve hours over weirs set up in weiring boxes. The leakage from the Cambridge branch was not measured until the first week in September, and the East Boston and Somerville branches are yet to be weired. The results indicate that the Metropolitan Sewers are commendably tight.

Table showing approximately the Amount of Leakage into the North Metropolitan System.

Location.	District Included.	Miles of Sewer.	Gallons in 24 Hours.
Deer Island, . . .	Pumping station to Shirley Gut, . .	0.5	91,500
Winthrop, ...	Shirley Gut siphon and main line to Belle Isle Inlet, ...	2.8	168,100
East Boston, . . .	Belle Isle Inlet and main line to East Boston pumping station, . . .	1.6	39,650
Chelsea, ...	Chelsea Creek to Spruce Street, Chelsea, with Section 11, ...	1.8	62,700
Everett, ...	Spruce Street, Chelsea, to bellmouth, West Everett, and Cambridge branch to Charlestown pumping station, .	2.5	77,450
Malden, ...	Bellmouth at West Everett to Melrose and Malden line, ...	2.5	78,900
Melrose, ...	To end of sewer, ...	1.3	40,000
Medford and Winchester,	Bellmouth at West Everett to Stoneham line, and Alewife Brook branch to pumping station, ...	9.0	179,700
Alewife Brook branch, .	Above Alewife Brook pumping station,	2.7	380,200
Cambridge branch, . .	Above Charlestown pumping station, .	5.6	133,400
Charlestown branch, .	– – –	2.0	133,100
Cummingville branch, .	– – –	0.9	63,000
Totals, ...		33.2	1,447,700

OPERATION OF PUMPING STATIONS.

At the Deer Island and East Boston stations, from June 1 to September 30, the pumps have been operated about four hours per day. At each station a force for a single shift only has been provided, as follows: an engineer in charge, 1 assistant engineer, 1 screenman, 1 fireman and 1 night watchman.

At the Charlestown station, to avoid silting of the tunnel under Mystic River, a force for two shifts has been provided, as follows: an engineer in charge, 1 assistant engineer, 2 screenmen, 2 firemen and 1 night watchman. This provides for a pumpage of seventeen hours per day, necessitating only the storage of the night flow in the Cambridge branch.

Engineers in charge at the stations have been appointed as follows: —

Engineer in charge, East Boston pumping station: Perry D. Blackden (appointed March 30, 1895).

Engineer in charge, Deer Island pumping station: Jeremiah B. Black (appointed March 23, 1895).

Engineer in charge, Charlestown pumping station: James W. Teague (appointed Aug. 24, 1895).

At the Alewife Brook pumping station a temporary plant has been in operation since June 1. During the months of June and July no sewage was delivered to it, and the plant was used for draining in connection with the day work construction of foundations and connections at the permanent station. During the month of August the city of Cambridge delivered sewage from the Massachusetts-avenue, Spruce-street and Concord-avenue areas into the Alewife Brook branch, and since that date the temporary pumping plant has been in continuous operation, raising sewage of that branch.

Table of Approximate Quantities and Lifts at Pumping Stations of North Metropolitan System.

1895.	Total Pumpage in Gallons, Deer Island Station.	Average Lift.	Total Pumpage in Gallons, East Boston Station.	Average Lift.	Total Pumpage in Gallons, Alewife Brook Station.	Average Lift.
June, . . .	117,000,000	11.4	109,500,000	15.0	-	-
July, . . .	120,000,000	10.7	112,500,000	15.0	-	-
August, . . .	134,000,000	10.4	122,000,000	13.8	11,000,000	13.1
September, . .	155,000,000	10.3	143,500,000	14.1	34,750,000	13.2
Totals, . .	526,000,000	-	487,500,000	-	45,750,000	-

For the four months that the stations have been in service the pumps have operated smoothly and effectively.

The following table indicates the order in which the main and branch lines of the North Metropolitan System were opened for service: —

Date of Opening.	Location.
June 1, . . .	Main line from the outlet to the Winchester line, and the Malden and Melrose branch, through Winthrop, Chelsea, Everett, Malden, Melrose, Medford, Belmont, Arlington and parts of Cambridge and Somerville.
June 29, . .	Main line through Winchester to end of the system.
July 18, . . .	Old Mystic Valley Sewer from its outlet to 80 feet beyond the Woburn line.
September 23, .	Cambridge branch above the Charlestown pumping station, including parts of Boston, Cambridge and Somerville.

The following branches yet remain to be opened for service: The East Boston branch, designed to receive sewage from the whole of East Boston; this branch is completed, excepting minor repairs.

The Somerville branch, designed to receive sewage from parts of Charlestown, Somerville and Medford; about 500 feet of this branch still remain to be constructed.

Table showing Cities and Towns connected with North Metropolitan System (not including Mystic Valley Sewer above Woburn Line), with Approximate Miles of Sewer connected, Number of House Connections, and Estimated Population contributing.

CITIES AND TOWNS.	Miles of Sewer connected.	Separate or Combined System.	Number of Connections with Local Sewers.	Estimated Population per Connection.*	Estimated Total Population contributing.
Winthrop, . .	6.85	Separate, .	52	6.80	354
Everett, . .	6.30	Separate, .	176	6.00	1,056
Melrose, . .	10.40	Separate, .	90	6.67	600
Malden, . .	28.40	Separate, .	400	5.40	2,160
Medford, . .	17.40	Separate, .	144	4.90	706
Winchester, .	9.10	Separate, .	39	5.27	206
Woburn, . .	1.80	Separate, .	-	-	-
Belmont, . .	2.70	Separate, .	3	-	50†
Cambridge, . .	18.30	Combined,	1,151	6.60	7,597
Totals, . .	101.25	-	-	-	12,729

* This is estimated from assessors' statement of the number of houses in each city or town, and the population from census of 1895.

† From Massachusetts General Hospital, Waverly.

MYSTIC VALLEY SEWER.

In accordance with your contract with the city of Boston, so much of the Mystic valley sewer as extends from the outlet at the head of the Lower Mystic Lake to a point 80 feet north of the Woburn city line came into your possession July 18, consisting of 11,287 linear feet 26 by 28 inch brick sewer, 2,890 linear feet 15-inch pipe sewer, and the precipitation works near the outlet, including settling tanks, mixers, steam plant and other appurtenances. The precipitation works were shut down on the night of July 18, and have not since been operated. At that date the estimated delivery through the Mystic Valley Sewer at the precipitation works is outlined in the accompanying table: —

Manufacturing Wastes and other Drainage.

NAME.	Location.	Number of Hides handled Daily.	Estimated Daily Delivery of Manufacturing Wastes into the Mystic Valley Sewer (Gallons).	Remarks.
Beggs & Cobb,	Swanton Street, Winchester, near Woburn line,	700	70,000	-
J. P. Crane,	Woburn, near Winchester line,	100	10,000	-
F. A. Loring,	Near Conn Street, Woburn,	200	-	Connected, but shut down on account of boiler explosion.
Middlesex Leather Company,	Near Conn Street, Woburn,	180	18,000	-
Eustis Cummings,	Near Fowle Street, Woburn,	150	15,000	-
James Skinner & Co.,	Near Green Street, Woburn,	50	5,000	-
E. C. Cottle,	Near Fowle Street, Woburn,	200	20,000	-
Total manufacturing wastes,			138,000	-
Estimated dry-weather flow of Russell's Brook, now entering Mystic Valley Sewer near Prospect Street, Woburn, including drainage from large steam laundry,			30,000	-
Estimated delivery from house-drain connections, Woburn and Winchester,			30,000	-
Estimated leakage,			90,000	-
Total estimated daily delivery, Mystic Valley branch, July 18, 1895,			288,000	-

In connection with the construction of Section 44½ at its point of crossing under the Mystic Valley Sewer, a stop-plank man-hole was introduced for deflecting the sewage of the Mystic Valley Sewer into the Metropolitan mains. On the evening of July 18 stop-planks were introduced in this man-hole on Section 44½, above referred to, and sewage from the Mystic Valley branch at that time turned into the Metropolitan System, where it has since been successfully handled. The Mystic Valley Sewer, as acquired, was found in a very foul condition. The sides and invert were coated to considerable depths with deposits of tan bark and hair. It was carefully cleaned for its whole length by the use of steel brushes and extension rods, and has since been maintained in normal condition.

A temporary connection with the Mystic Valley branch was granted to the town of Winchester for Beggs & Cobb's tannery, and a like connection to the city of Woburn for tanneries within its limits, on condition that all liquor from the tan presses should be excluded from the drainage, and that the drainage from beam houses be passed through efficient screens for the purpose of intercepting hair, fat and fragments of hide.

From July 18 to September 30 the Mystic Valley branch has been frequently and very carefully inspected. Traces of tan have at times been discovered, but on complaint to the proper authorities this has ceased. Slight traces of hair are still discovered. With improved screens at the beam houses this could be entirely removed. For two and one-half months the modified tannery drainage, as outlined above, has been continuously delivered through the Metropolitan Sewers, and on September 30 the Mystic Valley Sewer and Metropolitan mains are clean and in normal condition.

NEPONSET VALLEY SYSTEM.

In compliance with your request of June 5, a preliminary study has been made for an intercepting sewer in the Neponset River and Mother Brook valleys, designed to receive foul drainage from Dedham, Hyde Park, Milton, parts of the city of Boston and other areas, substantially as outlined in chapter 406 of the Acts of 1895. A report in relation thereto was submitted September 21. To Sept. 30, 1895, detailed surveys have been made from Central Avenue to Mattapan Square, and much topographical information obtained over possible routes for the intercepting sewers through Hyde Park and Dedham. Fifty-five pipe soundings have been made to locate ledge, and to determine with accuracy the character of the earth excavation.

I desire to express my high appreciation of your courtesy and kindness, and to thank all employees of the engineering department for their conscientious and intelligent service.

Respectfully submitted,

WILLIAM M. BROWN, Jr.,
Chief Engineer and Superintendent.

APPENDIX.

TABLE A.

BIDS FOR MISCELLANEOUS CONTRACTS UPON NORTH METROPOLITAN SYSTEM DURING THE YEAR ENDING SEPT. 30, 1895.

NAMES OF BIDDERS.	RESIDENCE.	CHARLESTOWN.				EAST BOSTON.			
		COAL-POCKET.	DREDGING.	IRON WORK FOR PUMPING STATION.	PLASTERING FOR PUMPING STATION.	WHARF.	COAL SHED.	SEA WALL.	SCREEN-HOUSE.
		Bids opened Aug. 24, '95.	Bids opened Mar. 30, '95.	Bids opened Sept. 7, '95.	Bids opened Sept. 7, '95.	Bids opened Dec. 22, '94.	Bids opened May 25, '95.	Bids opened Sept. 7, '95.	Bids opened May 25, '95.
Augustus Bellevue & Co.,	Boston,	–	$1,236 00	–	–	$944 00*	–	–	–
B. F. Nay & Co.,	Boston,	–	–	–	–	985 00	–	–	–
Benjamin Young,	Boston,	–	–	–	–	992 00	–	–	–
William L. Miller,	Boston,	–	–	–	–	1,031 00	–	–	–
Trumbull & Ryan,	Boston,	–	–	–	–	1,329 00	–	–	–
Josiah Shaw,	Boston,	–	1,230 00*	–	–	1,480 00	–	–	–
Nay & Ellis,	Boston,	–	–	–	–	1,650 00	–	–	–
W. H. Ellis & Co.,	East Boston,	–	1,270 00	–	–	–	–	–	–
Chas. G. Craib,	Winthrop Beach,	–	–	–	–	–	–	–	–
Chelmsford Foundry Co.,	Boston,	–	–	$873 00*	–	–	–	–	–
Barbour Stockwell Co.,	Boston,	–	–	1,219 19	–	–	–	–	–
Joel Knapp & Son,		–	–	–	–	–	–	–	–
G. W. & F. Smith Iron Co.,	Boston,	–	–	–	–	–	–	–	–
Wm. Richmond & Co.,	Boston,	–	–	–	–	–	$5,207 00	–	$2,410 00
John Y. Mainland,	Boston,	–	–	–	–	–	–	–	–
Philip H. Butler & Co.,	Boston,	–	–	–	–	–	–	–	–
Chas. E. Hall & Co.,	Boston,	–	–	–	–	–	–	–	–
Bowker, Torrey & Co.,	Boston,	–	–	–	–	–	–	–	–
J. J. Ford & Co.,	Boston,	–	–	–	$295 00	–	–	–	–
John Mack,	Boston,	–	–	–	267 09*	–	–	–	–
David McIntosh,	Boston,	–	–	–	–	–	–	–	–
The Atlantic Works,	East Boston,	–	–	–	–	–	–	–	–
Roberts Iron Works Co.,	Cambridgeport,	–	–	–	–	–	–	–	–
Pitkin Bros. & Co.,	Hartford, Conn.,	–	–	–	–	–	–	–	–
Portland Co.,	Portland, Me.,	–	–	–	–	–	–	–	–
James Russell Boiler Works,	South Boston,	–	–	–	–	–	–	–	–
Edw. Kendall & Sons,	Cambridgeport,	–	–	–	–	–	–	–	–
E. Hodge & Co.,	East Boston,	–	–	–	–	–	–	–	–
Wm. T. Eaton,	Boston,	$11,856 45	–	–	–	–	4,598 00*	–	2,382 00

O'Connell & Furbish,	Boston,	7,739 00	-	-	-	-	8,729 00	-	2,100 00*
W. H. Keyes & Co.,	Boston,	8,221 00	-	-	-	-	6,600 00	-	3,517 00
Lord Bros.,	Waltham,	-	-	-	-	-	-	-	-
Mack & Moore,	Boston,	7,400 00*	-	-	-	-	-	-	-
John Moyle,	Sharon,	-	-	-	-	-	-	-	-
McGahey & Byrne,	Cambridgeport,	-	-	-	-	-	-	-	-
Walter S. Sampson,	Boston,	-	-	-	-	-	-	-	-
Frank L. Allen,	Worcester,	-	-	-	-	-	-	-	-
Weaving, Booth & Parry,	Boston,	-	-	-	-	-	-	-	-
Craib & Trumbull,	Winthrop,	-	-	-	-	-	-	$1,050 00	-
L. K. Marston,	Boston,	8,033 00	-	-	-	-	-	-	-
E. B. Townsend,	Boston,	-	-	-	-	-	-	-	-
C. H. Sprague & Son,	Boston,	-	-	-	-	-	-	-	-
L. G. Burnham & Co.,	Boston,	-	-	-	-	-	-	-	-
C. A. Campbell & Co.,	Boston,	-	-	-	-	-	-	-	-
Alden & Nevin,	Boston,	-	-	-	-	-	-	-	-
Curran & Burton,	Boston,	-	-	-	-	-	-	-	-
Garfield & Proctor,	Boston,	-	-	-	-	-	-	-	-
John Sutherland,	Boston,	-	-	-	-	-	-	1,032 00	-
Cheney & Trumbull,	Boston,	-	-	-	-	-	-	893 75	-
W. H. Wyman,	Chelsea,	-	-	-	-	-	-	650 00*	-
Moore & Rushton,	Boston,	-	-	-	340 00	-	-	-	-
E. Littlefield & Co.,	Boston,	-	-	-	-	-	-	-	-
H. F. Miller,	Boston,	-	-	-	-	-	-	-	-
John McNamara,	Boston,	-	-	-	-	-	-	-	-
Geo. A. Cahill,	Boston,	-	-	-	-	-	-	-	-
John J. Flynn,	Boston,	-	-	-	-	-	-	-	-
Hersee Bros.,	Boston,	-	-	-	-	-	-	-	-
Isaac M. Tucker,	Boston,	-	-	-	-	-	-	-	-
John C. Kelley,	Boston,	-	-	-	-	-	-	-	-
Pierce & Cox,	Boston,	-	-	-	-	-	-	-	-
Crawford & Young,	Boston,	-	-	-	-	-	-	-	-
Lewis C. Watt,	Boston,	-	-	-	-	-	-	-	-

* Contract awarded to.

TABLE A — *Continued.*

BIDS FOR MISCELLANEOUS CONTRACTS UPON NORTH METROPOLITAN SYSTEM DURING THE YEAR ENDING SEPT. 30, 1895.

NAMES OF BIDDERS.	RESIDENCE.	EAST BOSTON.					DEER ISLAND.		
		COAL PER TON (2,240 LBS.).	IRON WORK FOR PUMPING STATION.	INTERIOR FINISH FOR PUMPING STATION.	MARBLE FLOORING FOR PUMPING STATION.	PLASTERING FOR PUMPING STATION.	IRON WORK FOR PUMPING STATION.	INTERIOR FINISH FOR PUMPING STATION.	MARBLE FLOORING FOR PUMPING STATION.
		Bids opened Sept. 7, '95.	Bids opened Apr. 27, '95.	Bids opened Apr. 27, '95.	Bids opened Apr. 27, '95.	Bids opened Apr. 27, '95.	Bids opened Apr. 27, '95.	Bids opened Apr. 27, '95.	Bids opened Apr. 27, '95.
Augustus Bellevue & Co.,	Boston,	-	-	-	-	-	-	-	-
B. F. Nay & Co.,	Boston,	-	-	-	-	-	-	-	-
Benjamin Young,	Boston,	-	-	-	-	-	-	-	-
William L. Miller,	Boston,	-	-	-	-	-	-	-	-
Trumbull & Ryan,	Boston,	-	-	-	-	-	-	-	-
Josiah Shaw,	Boston,	-	-	-	-	-	-	-	-
Nay & Ellis,	Boston,	-	-	-	-	-	-	-	-
W. H. Ellis & Co.,	East Boston,	-	-	-	-	-	-	-	-
Chas. G. Craib,	Winthrop Beach,	-	-	-	-	-	-	-	-
Chelmsford Foundry Co.,	Boston,	-	$547 70*	-	-	-	$556 70*	-	-
Barbour-Stockwell Co.,	Boston,	-	871 25	-	-	-	765 00	-	-
Joel Knapp & Son,	. . . . .	-	923 00	-	-	-	685 00	-	-
G. W. & F. Smith Iron Co.,	Boston,	-	1,362 00	-	-	-	1,147 00	-	-
Wm. Richmond & Co.,	Boston,	-	-	$1,789 00*	-	-	-	$2,110 00*	-
John Y. Mainland,	Boston,	-	-	2,038 00	-	-	-	2,063 00	-
Philip H. Butler & Co.,	Boston,	-	-	-	$510 00*	-	-	-	$567 00*
Chas. E. Hall & Co.,	Boston,	-	-	-	715 00	-	-	-	1,045 00
Bowker, Torrey & Co.,	Boston,	-	-	-	1,300 00	-	-	-	1,400 00
J. J. Ford & Co.,	Boston,	-	-	-	-	$235 00*	-	-	-
John Mack,	Boston,	-	-	-	-	306 00	-	-	-
David McIntosh,	Boston,	-	-	-	-	310 00	-	-	-
The Atlantic Works,	East Boston,	-	-	-	-	-	-	-	-
Roberts Iron Works Co.,	Cambridgeport,	-	-	-	-	-	-	-	-
Pitkin Bros. & Co.,	Hartford, Conn.,	-	-	-	-	-	-	-	-
Portland Co.,	Portland, Me.,	-	-	-	-	-	-	-	-
James Russell Boiler Works,	South Boston,	-	-	-	-	-	-	-	-
Edw. Kendall & Sons,	Cambridgeport,	-	-	-	-	-	-	-	-
E. Hodge & Co.,	East Boston,	-	-	-	-	-	-	-	-
Wm. T. Eaton,	Boston,	-	-	-	-	-	-	-	-

O'Connell & Furbish,	Boston,	-	-	-	-	-	-	-	-
W. H. Keyes & Co.,	Boston,	-	-	-	-	-	-	-	-
Lord Bros.,	Waltham,	-	-	-	-	-	-	-	-
Mack & Moore,	Boston,	-	-	-	-	-	-	-	-
John Moyle,	Sharon,	-	-	-	-	-	-	-	-
McGahey & Byrne,	Cambridgeport,	-	-	-	-	-	-	-	-
Walter S. Sampson,	Boston,	-	-	-	-	-	-	-	-
Frank L. Allen,	Worcester,	-	-	-	-	-	-	-	-
Weaving, Booth & Parry,	Boston,	-	-	-	-	-	-	-	-
Craib & Trumbull,	Winthrop,	-	-	-	-	-	-	-	-
L. K. Marston,	Boston,	-	-	-	-	-	-	-	-
E. B. Townsend,	Boston,	$3 65	-	-	-	-	-	-	-
C. H. Sprague & Son,	Boston,	3 46	-	-	-	-	-	-	-
L. G. Burnham & Co.,	Boston,	3 41	-	-	-	-	-	-	-
C. A. Campbell & Co.,	Boston,	3 33⅓	-	-	-	-	-	-	-
Alden & Nevin,	Boston,	3 32	-	-	-	-	-	-	-
Curran & Burton,	Boston,	3 24	-	-	-	-	-	-	-
Garfield & Proctor,	Boston,	3 10*	-	-	-	-	-	-	-
John Sutherland,	Boston,	-	-	-	-	-	-	-	-
Cheney & Trumbull,	Boston,	-	-	-	-	-	-	-	-
W. H. Wyman,	Chelsea,	-	-	-	-	-	-	-	-
Moore & Rushton,	Boston,	-	-	-	-	-	-	-	-
E. Littlefield & Co.,	Boston,	-	-	-	-	-	-	-	-
H. F. Miller,	Boston,	-	-	-	-	-	-	-	-
John McNamara,	Boston,	-	-	-	-	-	-	-	-
Geo. A. Cahill,	Boston,	-	-	-	-	-	-	-	-
John J. Flynn,	Boston,	-	-	-	-	-	-	-	-
Hersee Bros.,	Boston,	-	-	-	-	-	-	-	-
Isaac M. Tucker,	Boston,	-	-	-	-	-	-	-	-
John C. Kelley,	Boston,	-	-	-	-	-	-	-	-
Pierce & Cox,	Boston,	-	-	-	-	-	-	-	-
Crawford & Young,	Boston,	-	-	-	-	-	-	-	-
Lewis C. Watt,	Boston,	-	-	-	-	-	-	-	-

* Contract awarded to.

TABLE A — *Concluded.*

BIDS FOR MISCELLANEOUS CONTRACTS UPON NORTH METROPOLITAN SYSTEM DURING THE YEAR ENDING SEPT. 30, 1895.

NAMES OF BIDDERS.	RESIDENCE.	DEER ISLAND.				ALEWIFE BROOK.		BELLE ISLE INLET.	
		PLASTERING FOR PUMPING STATION.	COAL-POCKET AND SCREEN-HOUSE.	FOUR-FAMILY DWELLING-HOUSE.	PLUMBING FOR DWELLING-HOUSE.	PUMPING STATION.	BOILERS FOR PUMPING STATION.	REMOVING OBSTRUCTIONS.	OVERFLOW.
		Bids opened Apr. 27, '95.	Bids opened June 15, '95.	Bids opened Aug. 10, '95.	Bids opened Aug. 10, '95.	Bids opened June 8, '95.	Bids opened May 25, '95.	Bids opened Mar. 16, '95.	Bids opened July 6, '95.
Augustus Bellevue & Co.,	Boston,	-	-	-	-	-	-	-	-
B. F. Nay & Co.,	Boston,	-	-	-	-	-	-	-	-
Benjamin Young,	Boston,	-	-	-	-	-	-	-	-
William L. Miller,	Boston,	-	-	-	-	-	-	$2,490 00	-
Trumbull & Ryan,	Boston,	-	-	-	-	-	-	-	-
Josiah Shaw,	Boston,	-	-	-	-	-	-	-	-
Nay & Ellis,	Boston,	-	-	-	-	-	-	-	-
W. H. Ellis & Co.,	East Boston,	-	-	-	-	-	-	3,750 00	-
Chas. G. Craib,	Winthrop Beach,	-	-	-	-	-	-	2,400 00*	-
Chelmsford Foundry Co.,	Boston,	-	-	-	-	-	-	-	-
Barbour-Stockwell Co.,	Boston,	-	-	-	-	-	-	-	-
Joel Knapp & Son,		-	-	-	-	-	-	-	-
G. W. & F. Smith Iron Co.,	Boston,	-	-	-	-	-	-	-	-
Wm. Richmond & Co.,	Boston,	-	$18,627 00	$12,368 00	-	-	-	-	-
John Y. Mainland,	Boston,	-	-	-	-	-	-	-	-
Philip H. Butler & Co.,	Boston,	-	-	-	-	-	-	-	-
Chas. E. Hall & Co.,	Boston,	-	-	-	-	-	-	-	-
Bowker, Torrey & Co.,	Boston,	-	-	-	-	-	-	-	-
J. J. Ford & Co.,	Boston,	$275 00*	-	-	-	-	-	-	-
John Mack,	Boston,	351 60	-	-	-	-	-	-	-
David McIntosh,	Boston,	412 00	-	-	-	-	-	-	-
The Atlantic Works,	East Boston,	-	-	-	-	-	$1,395 00	-	-
Roberts Iron Works Co.,	Cambridgeport,	-	-	-	-	-	1,365 00	-	-
Pitkin Bros. & Co.,	Hartford, Conn.,	-	-	-	-	-	2,300 00	-	-
Portland Co.,	Portland, Me.,	-	-	-	-	-	1,480 00	-	-
James Russell Boiler Works,	South Boston,	-	-	-	-	-	1,135 00*	-	-
Edw. Kendall & Sons,	Cambridgeport,	-	-	-	-	-	1,317 00	-	-
E. Hodge & Co.,	East Boston,	-	-	-	-	-	1,269 00	-	-
Wm. T. Eaton,	Boston,	-	16,036 00	11,230 00	-	$5,719 00*	-	-	-

O'Connell & Furbish,	Boston,	-	-	10,722 00	-	8,300 00	-	-	-	-
W. H. Keyes & Co.,	Boston,	-	-	11,739 00	-	8,688 00	-	-	-	-
Lord Bros.,	Waltham,	-	-	-	-	6,875 00	-	-	-	-
Mack & Moore,	Boston,	-	14,900 00*	-	-	6,600 00	-	-	-	-
John Moyle,	Sharon,	-	16,057 00	-	-	-	-	-	-	-
McGahey & Byrne,	Cambridgeport,	-	17,979 00	-	-	-	-	-	-	-
Walter S. Sampson,	Boston,	-	18,650 00	-	-	-	-	-	-	-
Frank L. Allen,	Worcester,	-	-	-	-	-	-	-	-	$17,740 00†
Weaving, Booth & Parry,	Boston,	-	-	-	-	-	-	-	-	10,955 00†
Craib & Trumbull,	Winthrop,	-	-	-	-	-	-	-	-	9,775 00†
L. K. Marston,	Boston,	-	-	-	-	-	-	-	-	-
E. B. Townsend,	Boston,	-	-	-	-	-	-	-	-	-
C. H. Sprague & Son,	Boston,	-	-	-	-	-	-	-	-	-
L. G. Burnham & Co.,	Boston,	-	-	-	-	-	-	-	-	-
C. A. Campbell & Co.,	Boston,	-	-	-	-	-	-	-	-	-
Alden & Nevin,	Boston,	-	-	-	-	-	-	-	-	-
Curran & Burton,	Boston,	-	-	-	-	-	-	-	-	-
Garfield & Proctor,	Boston,	-	-	-	-	-	-	-	-	-
John Sutherland,	Boston,	-	-	-	-	-	-	-	-	-
Cheney & Trumbull,	Boston,	-	-	-	-	-	-	-	-	-
W. H. Wyman,	Chelsea,	-	-	-	-	-	-	-	-	-
Moore & Rushton,	Boston,	-	-	-	-	-	-	-	-	-
E. Littlefield & Co.,	Boston,	-	-	14,228 00	-	-	-	-	-	-
H. F. Miller,	Boston,	-	-	10,097 00	-	-	-	-	-	-
John McNamara,	Boston,	-	-	12,650 00	-	-	-	-	-	-
Geo. A. Cahill,	Boston,	-	-	10,793 00	-	-	-	-	-	-
John J. Flynn,	Boston,	-	-	10,674 00	-	-	-	-	-	-
Hersee Bros.,	Boston,	-	-	9,995 00*	-	-	-	-	-	-
Isaac M. Tucker,	Boston,	-	-	-	$1,374 00	-	-	-	-	-
John C. Kelley,	Boston,	-	-	-	1,325 00	-	-	-	-	-
Pierce & Cox,	Boston,	-	-	-	1,112 00	-	-	-	-	-
Crawford & Young,	Boston,	-	-	-	1,100 00	-	-	-	-	-
Lewis C. Watt,	Boston,	-	-	-	987 00*	-	-	-	-	-

* Contract awarded to.

† All bids rejected.

TABLE B.

NORTH METROPOLITAN SYSTEM.

	Location.	Bids opened.	Number of Bids.	Highest.	Lowest.	CONTRACT AWARDED TO—	Residence.	Amount bid on Items for Comparison.
Coal-pocket,	Charlestown,	Aug. 24, 1895,	5	$11,856 45	$7,400 00	Mack & Moore,	Boston,	$7,400 00
Dredging,	Charlestown,	Mar. 30, 1895,	3	1,270 00	1,230 00	Josiah Shaw,	Boston,	1,230 00
Iron work for pumping station,	Charlestown,	Sept. 7, 1895,	2	1,219 00	873 00	Chelmsford Foundry Co.,	Boston,	873 00
Plastering for pumping station,	Charlestown,	Sept. 7, 1895,	3	340 00	267 09	John Mack,	Boston,	267 09
Alewife Brook pumping station,	Somerville,	June 8, 1895,	5	8,628 00	5,719 00	William T. Eaton,	Boston,	5,719 00
Boilers for Alewife Brook pumping station,	Somerville,	May 25, 1895,	7	1,480 00	1,135 00	James Russell Boiler Works,	South Boston,	1,135 00
Wharf,	East Boston,	Dec. 22, 1894,	7	1,650 00	944 00	Augustus Bellevue & Co.,	Boston,	944 00
Coal shed,	East Boston,	May 25, 1895,	4	8,729 00	4,598 00	William T. Eaton,	Boston,	4,598 00
Sea wall,	East Boston,	Sept. 7, 1895,	4	1,050 00	650 00	W. H. Wyman,	Chelsea,	650 00
Screen-house,	East Boston,	May 25, 1895,	4	3,517 00	2,100 00	O'Connell & Furbish,	Boston,	2,100 00
Coal (per ton of 2,240 pounds),	East Boston,	Sept. 7, 1895,	7	3 65	3 10	Garfield & Proctor,	Boston,	3 10
Iron work for pumping station,	East Boston,	Apr. 27, 1895,	4	1,362 00	547 70	Chelmsford Foundry Co.,	Boston,	547 70
Interior finish for pumping station,	East Boston,	Apr. 27, 1895,	2	2,038 00	1,789 00	Wm. Richmond & Co.,	Boston,	1,789 00
Marble flooring for pumping station,	East Boston,	Apr. 27, 1895,	3	1,300 00	510 00	Philip H. Butler & Co.,	Boston,	510 00
Plastering for pumping station,	East Boston,	Apr. 27, 1895,	3	310 00	235 00	J. J. Ford & Co.,	Boston,	235 00
Iron work for pumping station,	Deer Island,	Apr. 27, 1895,	4	1,147 00	556 70	Chelmsford Foundry Co.,	Boston,	556 70
Interior finish for pumping station,	Deer Island,	Apr. 27, 1895,	2	2,110 00	2,063 00	Wm. Richmond & Co.,	Boston,	2,110 00
Marble flooring for pumping station,	Deer Island,	Apr. 27, 1895,	3	1,400 00	567 00	Philip H. Butler & Co.,	Boston,	567 00
Plastering for pumping station,	Deer Island,	Apr. 27, 1895,	3	412 00	275 00	J. J. Ford & Co.,	Boston,	275 00
Coal-pocket and screen-house,	Deer Island,	June 15, 1895,	6	18,650 00	14,900 00	Mack & Moore,	Boston,	14,900 00
Four-family dwelling-house,	Deer Island,	Aug. 10, 1895,	10	14,228 00	9,995 00	Hersee Bros.,	Boston,	9,995 00
Plumbing for four-family dwelling-house,	Deer Island,	Aug. 10, 1895,	5	1,374 00	987 00	Lewis C. Watt,	Boston,	987 00
Removing obstructions,	Belle Isle Inlet,	Mar. 16, 1895,	3	3,750 00	2,400 00	Chas. G. Craib,	Winthrop,	2,400 00
Overflow,	Belle Isle Inlet,	July 6, 1895,	3	17,740 00	9,775 00	All bids rejected.		
				$105,564 10	$69,519 59			

TABLE C.

MAINTAINING AND OPERATING NORTH METROPOLITAN SYSTEM OF SEWERAGE.

1894.	DR.			
May 17,	To appropriation made by chap. 131, Acts of 1894,	. .	. .	$43,000 00
1895.				
Mar. 19,	To appropriation made by chap. 138, Acts of 1895,	. .	. .	46,000 00
				$89,000 00
	CR.			
Apr. 30,	By pay rolls for month, East Boston station, .	$78 96		
30,	By pay rolls for month, Deer Island station, .	159 64		
30,	By supplies for month, ...	15 00		
			$253 60	
May 31,	By pay rolls for month, Alewife Brook station, .	$309 40		
31,	By pay rolls for month, East Boston station, .	265 50		
31,	By pay rolls for month, Deer Island station, .	417 12		
31,	By supplies (coal) for month, Deer Island station,	200 00		
			1,192 02	
June 30,	By pay rolls for month, Deer Island station, .	$484 94		
30,	By pay rolls for month, East Boston station, .	275 48		
30,	By pay rolls for month, Alewife Brook station, .	276 00		
30,	By pay rolls for month, general, ...	148 33		
30,	By supplies for month, Deer Island station, .	270 55		
30,	By supplies for month, East Boston station, .	470 29		
30,	By supplies for month, Alewife Brook station, .	202 51		
30,	By supplies for month, general, ...	128 94		
			2,257 04	
July 31,	By proportionate expenses, commissioners, chief engineer, clerk and others, to date, . . .	$1,612 03		
31,	By office supplies for month, ...	17 10		
31,	By pay rolls for month, Deer Island station, .	265 75		
31,	By supplies for month, Deer Island station, .	580 52		
31,	By boiler insurance, Deer Island station, . .	180 00		
31,	By pay rolls for month, East Boston station, .	137 64		
31,	By supplies for month, East Boston station, .	578 16		
31,	By boiler insurance, East Boston station, . .	180 00		
31,	By pay rolls for month, Alewife Brook station, .	68 20		
31,	By supplies for month, Alewife Brook station, .	156 75		
31,	By pay rolls for month, general, ...	282 79		
31,	By supplies for month, general, ...	109 26		
			4,168 20	
Aug. 31,	By proportionate expenses, commissioners, chief engineer, clerk and others, to date, . . .	$1,434 99		
31,	By office supplies for month, ...	397 01		
31,	By pay rolls for month, Deer Island station, .	621 51		
31,	By supplies for month, Deer Island station, .	109 65		
31,	By pay rolls for month, East Boston station, .	275 28		
31,	By supplies for month, East Boston station, .	374 39		
31,	By pay rolls for month, Alewife Brook station, .	134 40		
31,	By supplies for month, Alewife Brook Station, .	45 54		
31,	By supplies for month, Charlestown station, .	11 79		
31,	By pay rolls for month, general, ...	681 44		
31,	By supplies for month, general, ...	312 32		
			4,398 32	
Sept. 30,	By proportionate expenses of commissioners, chief engineer, clerk and others, to date, . .	$1,868 68		
30,	By supplies for month, ...	241 48		
30,	By pay rolls for month, Deer Island station, .	1,408 66		
30,	By supplies for month, Deer Island station, .	470 73		
30,	By pay rolls for month, East Boston station, .	560 12		
30,	By supplies for month, East Boston station, .	768 09		
30,	By pay rolls for month, Charlestown station, .	134 64		
30,	By supplies for month, Charlestown station, .	191 87		
30,	By pay rolls for month, Alewife Brook station, .	289 67		
30,	By supplies for month, Alewife Brook station, .	262 73		
30,	By pay rolls for month, general, ...	1,772 18		
30,	By supplies for month, general, ...	716 71		
			8,685 56	
				20,954 74
	Balance, ...	. .	. .	$68,045 26

Table D.

Maintaining and operating Charles River Valley System.

1894.	Dr.			
Oct. 1,	To balance unexpended from appropriation of 1894, ...	. .	. .	$13,962 11
1895.				
Feb. 14,	To appropriation made by chapter 6, Acts of 1895,	. .	. .	28,000 00
1894.	Cr.			$41,962 11
Oct. 31,	By amount paid city of Boston for disposing of sewage to Oct. 1, 1894, ...	$5,750 00		
31,	By amount paid for labor for month, . . .	72 24		
31,	By amount paid for inspector's salary for month,	70 00	$5,892 24	
Nov. 30,	By amount paid for inspector's salary for month,	$40 00		
30,	By amount paid for supplies for month, . .	9 62		
30,	By amount paid for labor for month, . . .	84 18	133 80	
Dec. 31,	By amount paid city of Boston for disposing of sewage to Jan. 1, 1895, ...	$5,750 00		
31,	By amount paid for labor for month, . . .	81 13		
31,	By amount paid for supplies for month, . .	9 17		
31,	By amount paid for inspector's salary for month,	55 00	5,895 30	
1895.				
Jan. 31,	By amount paid for proportionate expenses of commissioners, chief engineer and clerk to Sept. 30, 1894, ...	$1,295 00		
31,	By amount paid for labor for month, . . .	63 22		
31,	By amount paid for supplies for month, . .	3 05		
31,	By amount paid for inspector's salary for month,	40 00	1,401 27	
Feb. 28,	By amount paid for labor for month, . . .	$152 82		
28,	By amount paid for supplies for month, . .	54 10		
28,	By amount paid for inspector's salary for month,	45 00	251 92	
Mar. 31,	By amount paid city of Boston for disposing of sewage to April 1, 1895, ...	$6,000 00		
31,	By amount paid for labor for month, . . .	152 79		
31,	By amount paid for supplies for month, . .	52 30		
31,	By amount paid for inspector's salary for month,	45 00	6,250 09	
Apr. 30,	By amount paid for supplies for month, . .	$72 70		
30,	By amount paid for labor for month, . . .	109 74	182 44	
May 31,	By amount paid for labor for month, . . .	. . .	86 89	
June 30,	By amount paid for labor for month, . . .	$146 13		
30,	By amount paid for supplies for month, . .	3 62	149 75	
July 31,	By amount paid city of Boston for disposing of sewage to July 1, 1895, ...	$6,000 00		
31,	By amount paid for salaries, commissioners, etc., to July 31, 1895, ...	300 00		
31,	By amount paid for labor for month, . . .	179 94		
31,	By amount paid for supplies for month, . .	7 86	6,487 80	
Aug. 31,	By amount paid for labor for month, . . .	$124 75		
31,	By amount paid for supplies for month, . .	4 36		
31,	By amount paid for salaries, commissioners, etc., to Aug. 31, 1895, ...	300 00	429 11	
Sept. 30,	By amount paid for salaries, commissioners, etc., to Sept. 30, 1895, ...	$300 00		
30,	By amount paid for labor for month, . . .	193 15		
30,	By amount paid for supplies for month, . .	12 00	505 15	
				27,665 76
	Balance, ...	. .	. .	$14,296 35

EXPENDITURES OF BOARD OF METROPOLITAN SEWERAGE COMMISSIONERS TO SEPT. 30, 1895.

	Year ending Sept. 30, 1889.	Year ending Sept. 30, 1890.	Year ending Sept. 30, 1891.	Year ending Sept. 30, 1892.	Year ending Sept. 30, 1893.	Year ending Sept. 30, 1894.	Year ending Sept. 30, 1895.	Totals.
Office expenses,	$1,161 29	$28,792 85	$30,437 29	$31,220 76	$35,191 97	$33,669 39	$19,652 19	$180,125 74
North Metropolitan system,	-	116,492 55	582,966 06	962,798 49	1,172,269 02	1,115,190 19	606,488 61	4,556,204 92
Charles River system,	-	18,329 41	381,149 33	280,308 29	28,882 27	25,369 13	1,927 35	735,965 78
Both systems,	-	2,696 20	5,597 86	7,703 15	12,783 61	15,864 20	302 20	44,947 22
Neponset valley system,	-	-	-	-	-	-	2,649 95	2,649 95
	$1,161 29	$166,311 01	$1,000,150 54	$1,282,030 69	$1,249,126 87	$1,190,092 91	$631,020 30	$5,519,893 61

Total amount expended to Sept. 30, 1895, . . . $5,519,893.61.

Expenses of Board of Metropolitan Sewerage Commissioners for the Year ending Sept. 30, 1895.

Office Expenses.

	1894.			1895.									Totals.
	October.	November.	December.	January.	February.	March.	April.	May.	June.	July.	August.	September.	
Salaries, — Commissioners, . .	$750 00	$750 00	$750 00	$750 00	$750 00	$750 00	$750 00	$750 00	$750 00	–	–	–	$6,750 00
Clerk and chief engineer, .	833 33	833 33	468 34	368 33	313 33	208 34	208 33	208 33	208 34	–	–	–	3,650 00
Clerical services, ...	381 66	381 66	381 67	381 66	381 66	381 67	381 66	381 66	275 00	–	$25 00	$6 09	3,359 39
Cement testing, ...	100 00	100 00	100 00	100 00	100 00	100 00	–	–	–	–	–	–	600 00
Care of offices, ...	26 00	26 00	26 00	–	46 00	20 00	–	40 00	20 00	–	20 00	40 00	264 00
Travelling expenses, . . .	5 90	–	–	–	–	7 64	–	–	–	–	–	–	13 54
Supplies, ...	128 63	75 95	224 72	20 25	94 49	94 31	204 10	157 76	161 79	$35 65	144 88	103 18	1,445 74
Rent of offices, ...	254 17	254 17	254 17	254 17	254 17	254 17	254 17	254 17	254 17	254 17	254 17	254 17	3,050 04
Photography, ...	52 06	8 83	52 67	–	3 82	2 05	5 35	15 46	9 50	–	8 93	1 45	160 12
Postage, telegrams and express, .	13 11	45 00	–	–	51 75	28 65	–	45 00	–	–	45 00	10 00	238 51
Engineers' instruments, . .	3 00	26 00	–	–	–	–	–	–	–	–	–	–	29 00
Blue printing, ...	–	2 20	–	–	22 67	21 50	–	15 37	16 10	13 01	–	–	90 85
Books and atlases, ...	–	–	–	–	–	1 00	–	–	–	–	–	–	1 00
Totals, ...	$2,547 86	$2,503 14	$2,257 57	$1,874 41	$2,017 89	$1,869 36	$1,803 61	$1,867 75	$1,694 90	$302 83	$497 98	$414 89	$19,652 19

EXPENSES OF BOARD OF METROPOLITAN SEWERAGE COMMISSIONERS FOR THE YEAR ENDING SEPT. 30, 1895.

North Metropolitan System.

	1894.			1895.									Totals.
	October.	November.	December.	January.	February.	March.	April.	May.	June.	July.	August.	September.	
Salaries, — engineers, inspectors and all others, including labor, . .	$5,025 04	$5,151 49	$4,515 08	$4,019 29	$588 41	$8,259 06	$4,187 55	$4,415 50	$3,515 86	$2,674 27	$3,455 88	$3,930 87	$49,738 30
Travelling expenses, .	75 58	187 46	86 41	217 14	49 66	152 36	40 65	124 48	87 25	68 60	34 95	97 54	1,222 08
Postage, telegrams and express, ...	30 75	14 45	-	6 14	3 27	60	3 20	9 80	88 75	37 50	17 50	16 35	228 31
Moulds, patterns and castings, ...	-	-	-	-	-	-	-	18 10	-	-	-	-	18 10
Manhole covers, etc., .	395 09	100 90	191 13	-	305 61	-	204 09	-	-	-	-	-	1,196 82
Land taking, purchase and recording, : .	3,966 45	387 95	940 81	91 30	766 54	2,038 80	-	128 80	906 09	20 00	1,732 48	1,003 25	11,982 47
Experts and appraisers,	70 00	-	-	-	72 00	72 69	150 00	-	-	-	-	50 00	414 69
Tools and repairs of same, ...	-	-	-	-	-	-	-	-	-	28 00	-	10 50	38 50
Repairing water pipes, .	-	494 86	-	-	-	-	-	-	-	-	-	-	494 86
Medical and legal services, ...	-	-	-	400 00	-	-	-	450 00	1,672 00	-	-	85 00	2,607 00
Cement and gravel, . .	5 25	255 00	63 00	45 00	-	-	-	50 10	-	-	-	-	418 35
Advertising for proposals, ...	-	-	-	-	-	-	-	-	-	58 50	40 63	-	99 13
Lumber and field supplies, ...	1,062 26	927 60	793 52	871 93	944 93	219 56	257 76	477 89	144 17	417 70	335 71	92 46	6,545 49
Brick, ...	158 00	-	-	-	-	-	-	-	-	-	-	-	158 00

EXPENSES OF BOARD OF METROPOLITAN SEWERAGE COMMISSIONERS FOR THE YEAR ENDING SEPT. 30, 1895 —*Continued.*

North Metropolitan System — Continued.

	1894.			1895.									Totals.
	October.	November.	December.	January.	February.	March.	April.	May.	June.	July.	August.	September.	
Payments on Contract Work.													
*Sect. 1 — Deer Island, .	$11,227 85	$5,290 08	$14,284 58	$2,947 18	$2,653 09	$595 42	$522 68	$195 16	$37 72	$47 50	$35 00	-	$37,836 26
*Sect. 3½ — Shirley Gut, .	93 40	341 48	221 30	-	20 00	-	-	8 00	-	-	-	-	684 18
Trumbull & Ryan, contractors, —													
*Sect. 7 — East Boston and Winthrop, . .	3,359 08	4,778 04	7,098 31	4,678 87	5,631 57	3,524 80	184 69	1,342 90	1,539 50	12 55	385 74	$2,480 11	35,016 16
*Sect. 10 — Chelsea Creek, ...	301 31	-	71 80	117 66	25 00	1,308 16	1,030 60	610 61	155 80	1 50	-	1 50	3,623 94
Charles Linehan, contractor, —													
Sect. 11 — Chelsea, .	3,551 00	3,485 05	2,777 27	2,206 31	1,527 39	-	2,644 58	-	1 84	-	-	50	16,193 94
Orrin P. Roberts, contractor, —													
Sect. 12 — Chelsea, .	-	-	-	-	-	4,000 00	-	-	-	-	-	-	4,000 00
Metropolitan Construction Co., contractors —													
Sect. 14 — Chelsea, .	-	500 00	-	-	4,000 00	-	-	-	1,500 00	-	-	-	6,000 00
Part of Sect. 27 — Somerville and Cambridge, ...	-	-	-	-	-	567 90	-	-	-	-	-	-	567 90
Sect. 31 — Charlestown,	5,357 88	4,838 83	5,892 21	3,170 70	1,349 68	5,811 37	1,615 44	1,840 64	6 00	2 80	2 62	1 40	29,889 57
Sect. 32 — Charlestown,	5,839 84	3,366 77	3,338 24	1,591 01	-	3,772 85	-	1,449 55	-	-	-	-	19,358 26
Sect. 39 — East Boston,	2,112 70	1,512 39	1,134 99	2,390 71	387 95	1,957 29	1,442 26	-	-	-	-	-	10,938 29
Sect. 43 — Somerville and Cambridge, .	-	-	-	-	-	-	-	-	23 85	-	-	-	23 85
Sect. 43½ — Medford and Somerville, . .	-	-	-	-	-	-	-	-	6 70	-	-	-	6 70

National Construction Co., contractors, —													
Sect. 21 — Medford, .	-	-	-	-	-	-	-	-	42 56	-	-	-	42 56
Sect. 36 — East Boston,	917 98	-	-	108 00	-	-	-	54 00	-	-	-	-	1,079 98
*Sect. 19 — Malden River,	4,130 35	2,999 48	4,709 66	1,608 39	308 88	52 73	51 29	35	5 25	-	-	-	13,866 38
John Sheehan, contractor, —													
Sect. 37 — East Boston,	17 57	14 40	-	-	-	-	-	-	-	-	-	-	31 97
*Sect. 25 — Lower Mystic River siphon, .	1,039 63	640 52	29 17	1 05	20	13 50	84 54	13 50	-	297 10	35 00	15 25	2,169 46
*Sect. 25½ — Tufts' Mill Pond, ...	-	-	-	-	-	80 57	1 55	27 00	250 60	295 55	-	50	655 77
McGovern & Kitch, contractors, —													
Sect. 27 — Somerville and Cambridge, . .	22 00	-	-	-	-	-	-	-	-	-	-	-	22 00
Lindsey & Cudmore, contractors, —													
Sect. 47 — Winchester and Woburn, . .	2,029 10	1,292 78	912 82	-	-	-	-	456 42	-	-	-	-	4,691 12
*Sect. 32 — Charlestown Navy Yard, . .	2,960 37	3,171 53	3,240 34	1,435 42	46 27	120 95	-	-	73 15	4 00	-	-	11,052 03
James Heath & Son, contractors, —													
Sect. 35 — Charlestown, Somerville and Medford, ...	6,353 11	4,954 93	9,133 94	3,751 78	2,914 63	3,988 06	2,928 36	1,619 46	1,796 34	1,868 55	2,030 80	1,307 21	42,647 17
Sect. 38 — East Boston,	-	4,081 66	5,151 67	-	4,623 44	4,269 48	-	2,750 49	3,875 00	1,117 43	-	-	25,869 17
*Sect. 37 — East Boston,	-	-	1,383 10	1,678 76	2,164 15	1,664 12	85 70	21 36	122 72	29 00	7 38	-	7,156 29
*Sect. 37½ — Chelsea Creek, ...	86 22	61 89	119 10	-	-	-	-	-	-	-	-	-	267 21
*Sect. 38 — East Boston,	-	-	-	91 51	113 00	180 33	20 12	-	102 08	8 10	111 19	51 72	678 05
*Sect. 39 — East Boston,	1,774 11	4,141 77	3,695 19	3,115 67	3,366 39	4,001 85	1,502 38	614 35	916 71	117 96	197 82	4 75	23,448 95
Moulton & O'Mahoney, contractors, —													
Sect. 41 — Malden and Melrose, . . .	-	-	-	-	-	-	-	-	4 36	-	137 25	-	141 61

* Work done by day labor.

Expenses of Board of Metropolitan Sewerage Commissioners for the Year ending Sept. 30, 1895 — *Continued.*

North Metropolitan System — Concluded.

	1894.			1895.									Totals.
	October.	November.	December.	January.	February.	March.	April.	May.	June.	July.	August.	September.	
Hersee Bros., contractors, — Four-family wooden house at Deer Island,	-	-	-	-	-	-	-	-	-	-	-	$443 90	$443 90
*Upper Mystic River siphon,	$1,215 05	$2,998 60	$1,801 12	$1,576 54	$484 79	$135 11	$1 00	-	-	-	-	-	8,212 21
*Section 48,	-	-	-	-	-	-	-	-	$238 68	$1,901 71	$3,911 50	2,684 94	8,736 83
Mystic valley sewer connection,	317 90	7 55	24 50	-	-	-	-	-	-	-	-	-	349 95
*Arlington Avenue connection,	-	-	199 01	724 36	444 13	70 90	1 00	-	-	-	-	-	1,439 40
*Abbajona River siphon,	329 25	-	1 50	86 00	5 25	-	-	-	-	-	-	-	422 00
*East Boston pumping station,	920 84	1,195 08	2,269 74	361 41	1,607 39	3,032 17	1,547 74	$1,906 29	1,730 29	3,387 00	685 38	78 90	18,722 23
*Deer Island pumping station,	5,120 05	1,896 52	2,884 01	2,048 34	2,915 02	2,337 45	1,135 20	3,408 01	4,083 22	4,346 65	2,305 88	919 11	33,699 46
*Charlestown pumping station,	9,904 45	11,710 08	8,186 46	8,604 89	5,659 58	5,277 71	3,970 42	2,975 32	7,144 59	4,074 46	2,750 96	319 70	70,578 62
*Alewife Brook pumping station,	-	-	-	-	-	-	-	323 03	3,612 32	2,192 74	1,943 86	336 88	8,408 83
Deer Island:													
Edward P. Allis Co., contractors, — Pumps,	-	-	-	-	-	-	-	277 50	14,250 00	-	-	-	14,527 50
Gooch & Pray, contractors, — Pumping station,	-	-	-	6,671 55	-	-	3,299 00	-	-	-	-	489 70	10,460 25
East Boston:													
Edward P. Allis Co., contractors, — Pumps,	-	9,085 80	-	-	-	-	-	277 50	13,250 00	-	-	-	22,613 30

Edward E. Strout, contractor, — Pumping station, .	–	–	–	–	3,177 60	–	–	1,149 30	–	–	–	402 28	4,729 18
Charlestown:													
Edward P. Allis Co., contractors, — Pumps, ...	–	–	8,168 81	–	–	–	–	–	–	100 00	–	–	8,268 81
Edward Lynch & Co., contractors, — Pumping station, .	–	–	2,295 00	–	2,125 00	–	3,910 00	–	2,720 00	–	–	–	11,050 00
Somerville:													
Wm. T. Eaton, contractor, — Alewife Brook pumping station, . .	–	–	–	–	–	–	–	–	–	–	–	2,975 00	2,975 00
Wm. T. Eaton, contractor, — East Boston coal-pocket, ...	–	–	–	–	–	–	–	–	–	–	2,975 00	117 99	3,092 99
Mack & Moore, contractors, —													
Deer Island coal-pocket and screen-house, .	–	–	–	–	–	–	–	–	–	–	151 93	3,060 00	3,211 93
Charlestown coal-pocket, ...	–	–	–	–	–	–	–	–	–	–	278 62	1,146 73	1,425 35
Grand totals, . .	$79,769 46	$79,884 94	$95,613 79	$54,616 91	$48,280 82	$57,505 79	$30,821 80	$26,995 41	$63,903 40	$23,409 17	$23,563 08	$22,124 04	$606,488 61

* Work done by day labor.

EXPENSES OF BOARD OF METROPOLITAN SEWERAGE COMMISSIONERS FOR THE YEAR ENDING SEPT. 30, 1895 — *Continued.*

Charles River System.

	1894.			1895.									Totals.
	October.	November.	December.	January.	February.	March.	April.	May.	June.	July.	August.	September.	
Engineers, inspectors and others,	$25 00	$25 00	$25 00	$25 00	$141 60	$25 00	$25 00	$25 00	$25 00	-	-	-	$341 60
Legal services,	-	1,000 00	-	550 75	-	-	-	-	-	-	-	-	1,550 75
Land taking, purchase and recording,	-	-	-	-	35 00	-	-	-	-	-	-	-	35 00
Totals,	$25 00	$1,025 00	$25 00	$575 75	$176 60	$25 00	$25 00	$25 00	$25 00	-	-	-	$1,927 35

Both Systems.

	October.	November.	December.	January.	February.	March.	April.	May.	June.	July.	August.	September.	Totals.
Sheriff's fees,	-	-	-	$13 40	-	-	$6 80	-	-	-	-	-	$20 20
Engineers, inspectors and others,	-	-	-	-	$282 00	-	-	-	-	-	-	-	282 00
Totals,	-	-	-	$13 40	$282 00	-	$6 80	-	-	-	-	-	$302 20

EXPENSES OF BOARD OF METROPOLITAN SEWERAGE COMMISSIONERS FOR THE YEAR ENDING SEPT. 30, 1895 — *Concluded.*

Neponset Valley System.

	1894.			1895.									Totals.
	October.	November.	December.	January.	February.	March.	April.	May.	June.	July.	August.	September.	
Commissioners,	–	–	–	–	–	–	–	–	–	$250 00	$250 00	$250 00	$750 00
Office expenses,	–	–	–	–	–	–	–	–	–	45 00	–	120 96	165 96
Engineers, inspectors and others,	–	–	–	–	–	–	–	–	–	–	–	1,527 48	1,527 48
Travelling expenses,	–	–	–	–	–	–	–	–	–	–	–	104 09	104 09
Tools and repair of same,	–	–	–	–	–	–	–	–	–	–	–	1 55	1 55
Maps, plans, blue-prints, etc.,	–	–	–	–	–	–	–	–	–	–	–	54 47	54 47
Field supplies,	–	–	–	–	–	–	–	–	–	–	–	32 90	32 90
Telephone,	–	–	–	–	–	–	–	–	–	–	–	30	30
Teaming and express,	–	–	–	–	–	–	–	–	–	–	–	13 20	13 20
Totals,	–	–	–	–	–	–	–	–	–	$295 00	$250 00	$2,104 95	$2,649 95

ASSETS AND LIABILITIES SEPT. 30, 1895.

ASSETS.

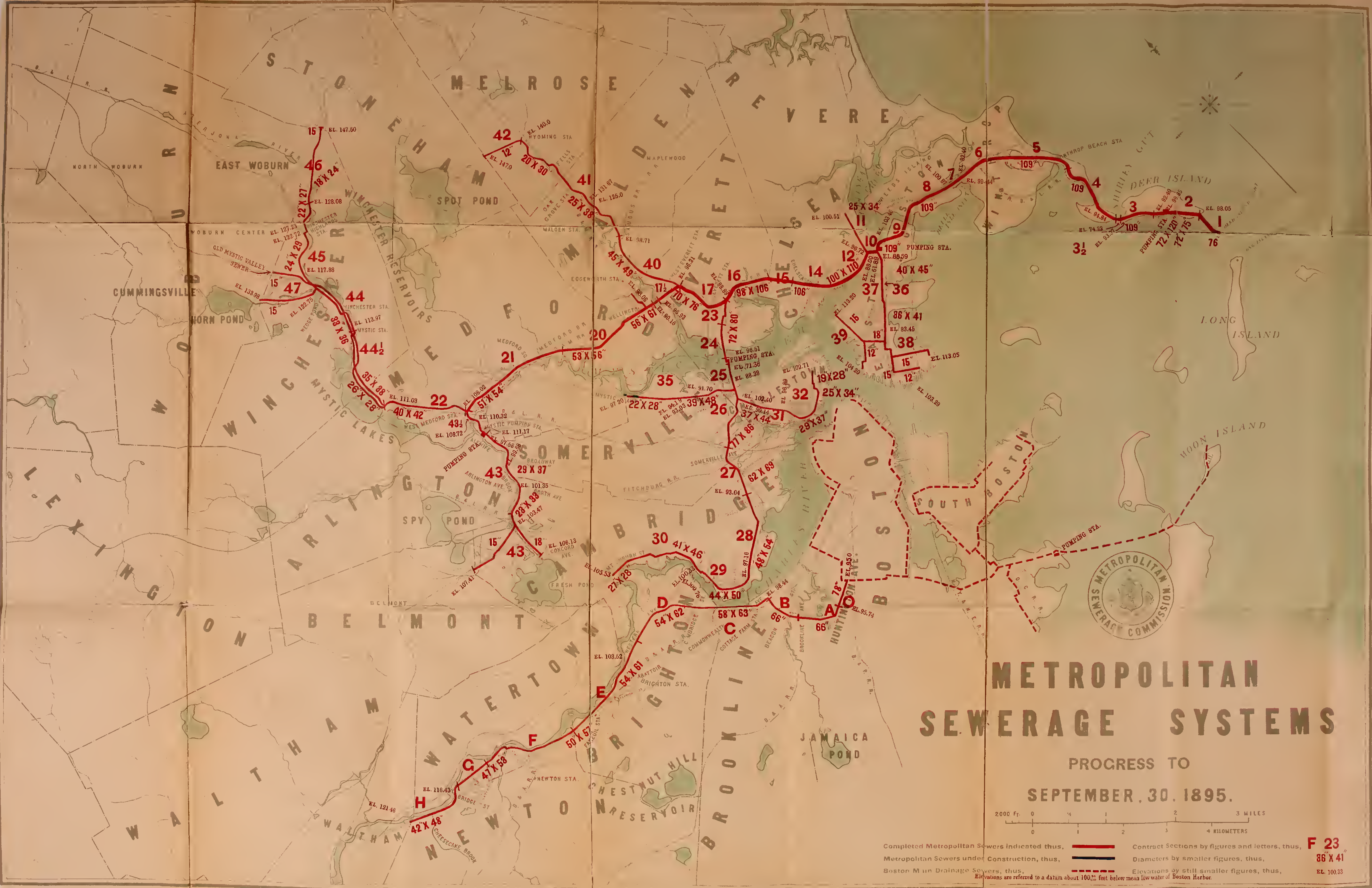
Office furniture, fittings and supplies, including fittings for pumping stations, field offices, stationery supplies and railroad tickets,		$3,013 50
Engineering instruments and supplies,		3,688 66
Engines, pumps, boilers, derricks, inclines and heavy appliances,		12,702 71
Miscellaneous tools,		2,487 97
Miscellaneous supplies, including lumber, brick, cement, etc.,		4,662 96
Engineers' field offices, sheds and tool-houses,		2,847 50
Stock yard and building, East Boston,		2,500 00
House and lot, Pearl Street, Chelsea,		3,500 00
Vacant lots, Winthrop,		1,800 00
Cash received as follows: —		
Balance Sept. 30, 1894,	$1,253 89	
For sale of old lumber, iron, etc.,	87 88	
For sale of old furniture,	62 19	
For sale of second-hand transits,	120 00	
For sale of field office, engineers' instruments, second-hand boiler, experimental arches and supplies,	558 18	
For rent of room 34, Walker building,	37 50	
For rent of house 63 Pearl Street, Chelsea,	138 00	
		2,257 64
		$39,460 94

There are numerous necessary plans, drawings, calculations and studies relating to the work, to which no stated value can be assigned; also about fifty miles of completed sewer, with pumping stations, siphons and other accessories necessary for operating the systems.

LIABILITIES.

Salaries due engineers, inspectors, rodmen, laborers and others,	$938 10
Due for labor for maintaining North Metropolitan System,	167 04
Due for labor for maintaining Charles River Valley System,	59 00
Amounts due contractors,	11,569 70
Amounts due sundry parties for cement and brick,	2,528 50
Sundry small bills,	3,725 82
	$18,988 16

There are also amounts due contractors upon a very few sections of the work, which will be paid on succeeding estimates or after the completion of the contracts.



METROPOLITAN SEWERAGE SYSTEMS

PROGRESS TO SEPTEMBER, 30, 1895.

2000 FT. 0 ¼ 1 2 3 MILES
0 1 2 3 4 KILOMETERS

Completed Metropolitan Sewers indicated thus, ▬

Metropolitan Sewers under Construction, thus, ▬

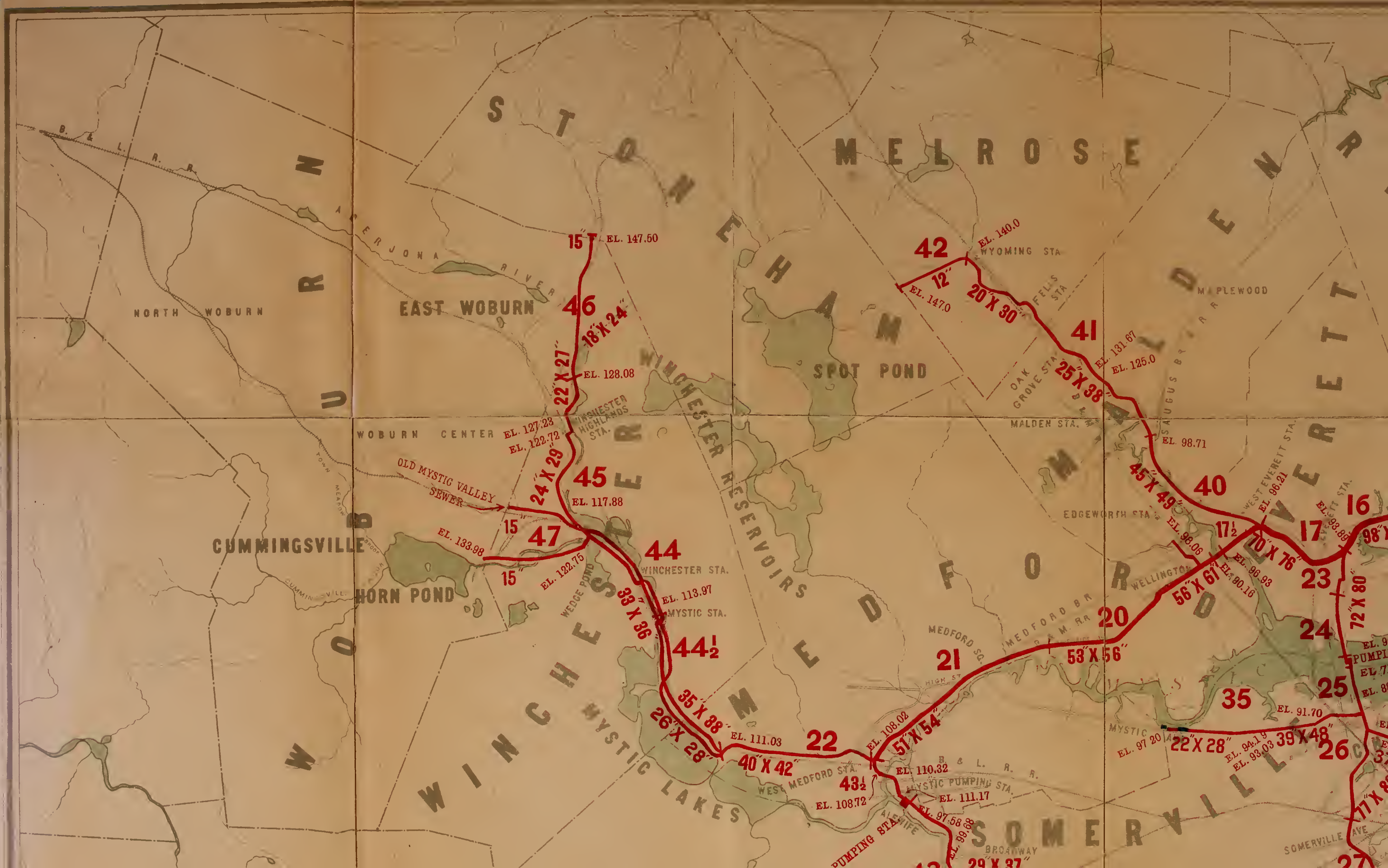
Boston Main Drainage Sewers, thus, - - - - - -

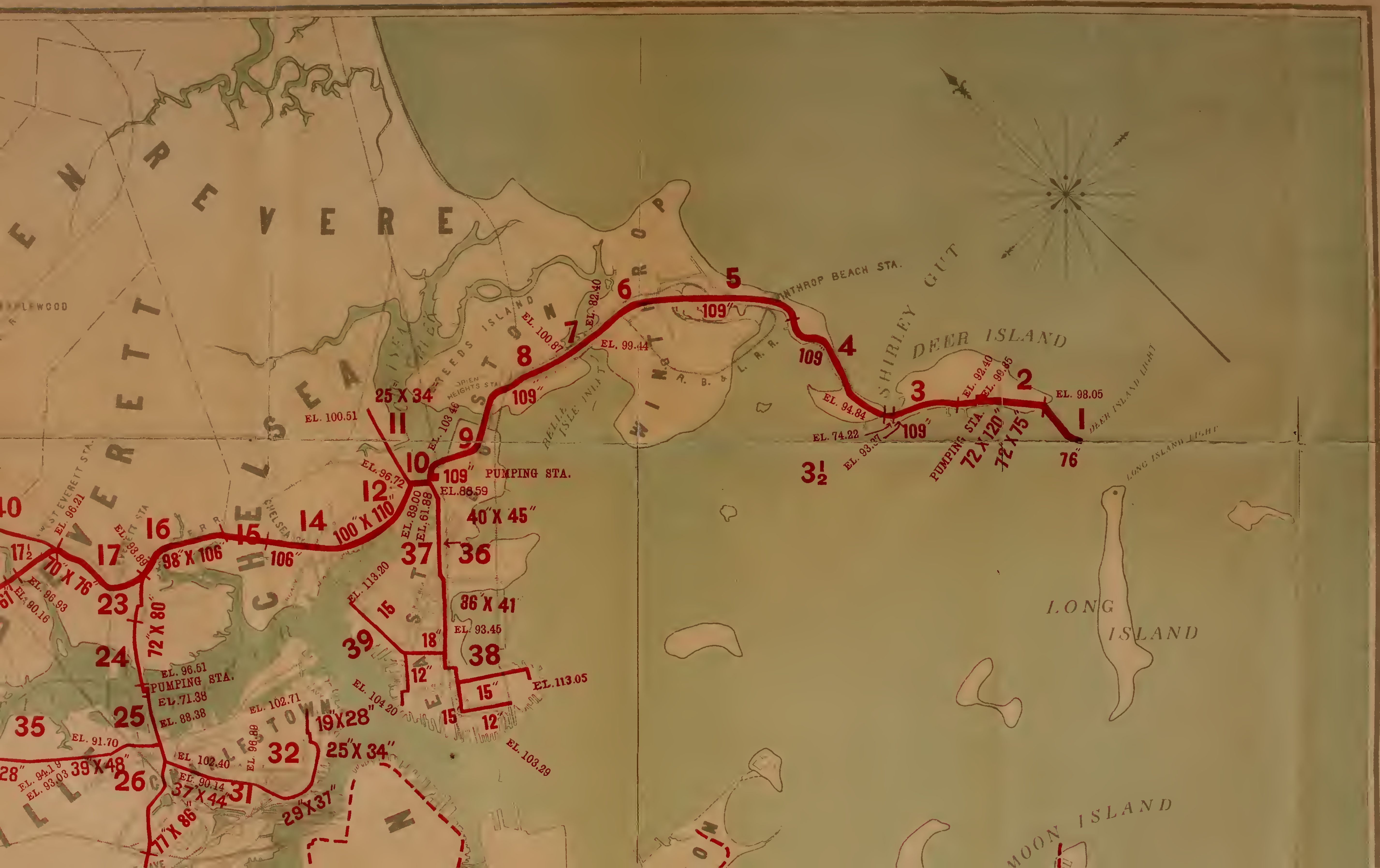
Contract Sections by figures and letters, thus, F 23

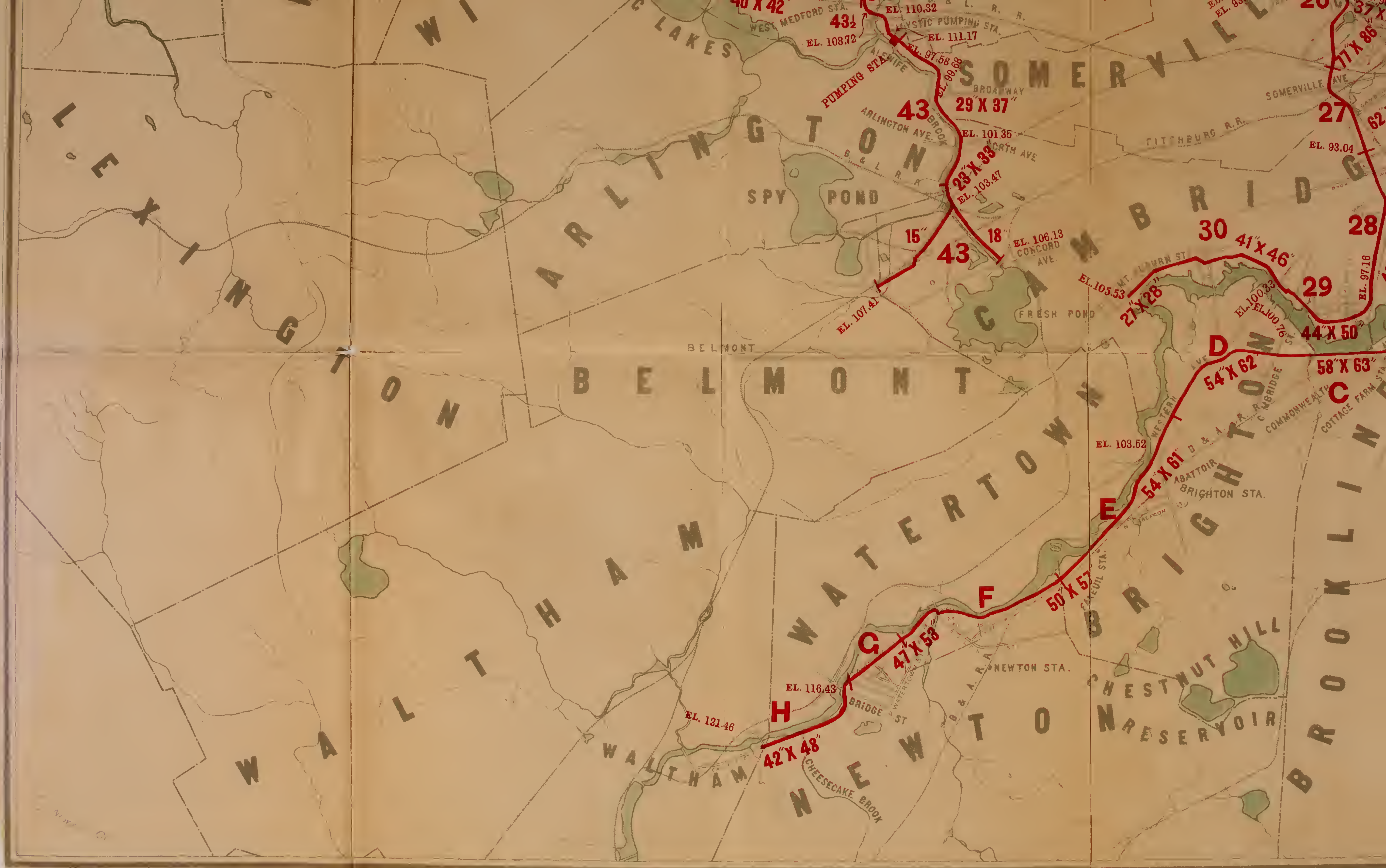
Diameters by smaller figures, thus, 36" X 41"

Elevations by still smaller figures, thus, EL. 100.33

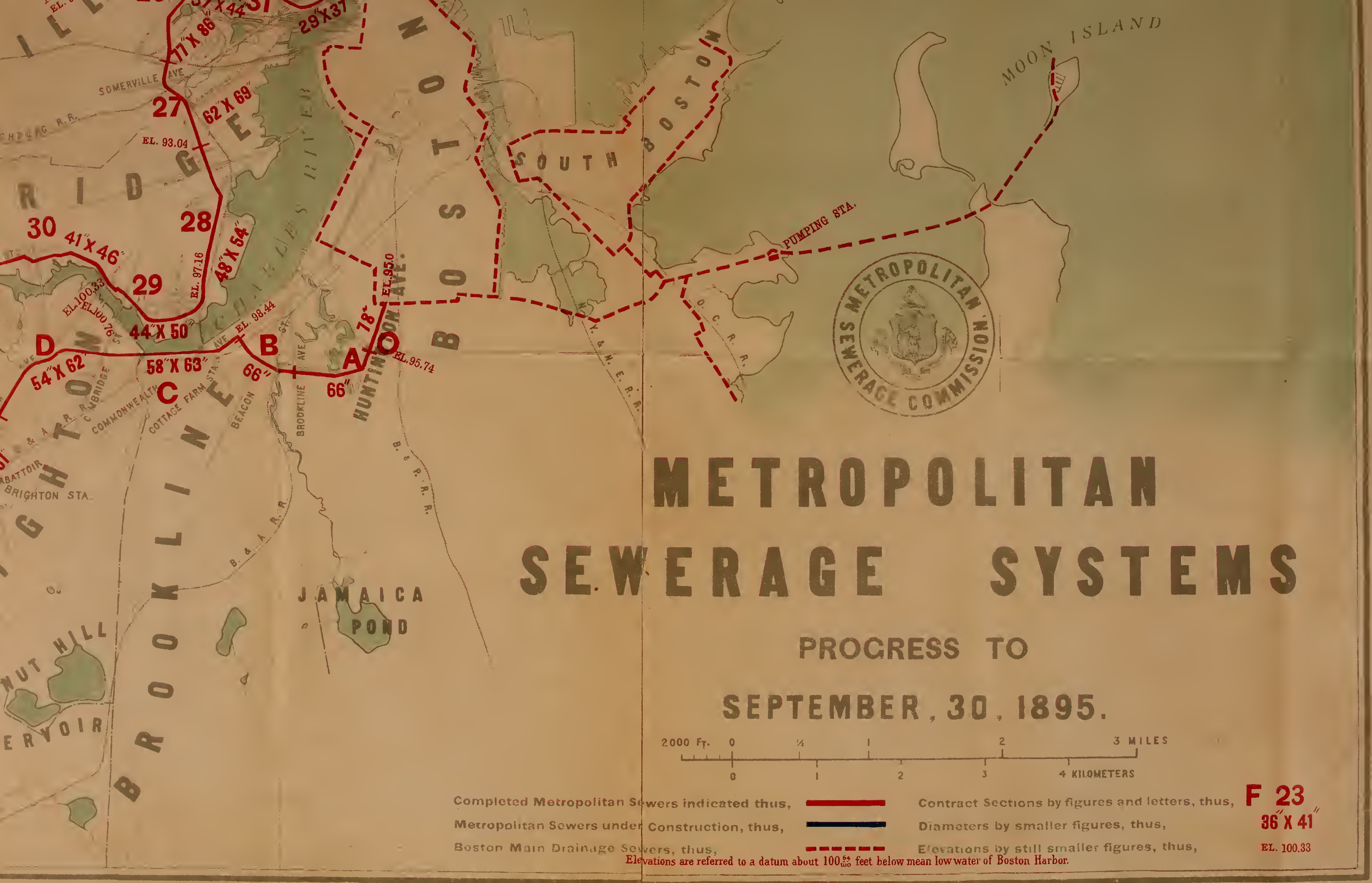
Elevations are referred to a datum about $100\frac{54}{100}$ feet below mean low water of Boston Harbor.


B. & L. R. R.
ABERJONA RIVER
NORTH WOBURN
EAST WOBURN
WOBURN
STONEHAM
MELROSE
MALDEN
EVERETT
SPOT POND
WINCHESTER
MEDFORD
SOMERVILLE
WOBURN CENTER
CUMMINGSVILLE
HORN POND
WEDGE POND
WINCHESTER RESERVOIRS
MYSTIC LAKES
TOWN MEADOW BROOK
CUMMINGSVILLE
OLD MYSTIC VALLEY SEWER
15"
EL. 147.50
46
18"X 24"
22"X 27"
EL. 128.08
WINCHESTER HIGHLANDS STA.
EL. 127.23
EL. 122.72
24"X 29"
45
EL. 117.88
15"
47
EL. 133.98
15"
EL. 122.75
44
WINCHESTER STA.
EL. 113.97
MYSTIC STA.
33"X 36"
44½
35"X 38"
26"X 28"
EL. 111.03
22
40"X 42"
WEST MEDFORD STA.
43½
EL. 108.72
EL. 108.02
51"X 54"
EL. 110.32
MYSTIC PUMPING STA.
EL. 111.17
ALEWIFE
PUMPING STA.
EL. 97.58
EL. 99.88
BROADWAY
29"X 37"
B. & L. R. R.
42
EL. 140.0
WYOMING STA.
12"
EL. 147.0
20"X 30"
FELLS STA.
41
EL. 131.67
EL. 125.0
OAK GROVE STA.
25"X 38"
B. & M.
MALDEN STA.
EL. 98.71
SAUGUS BR. R. R.
MAPLEWOOD
45"X 49"
EDGEWORTH STA.
40
EL. 98.06
17½
WEST EVERETT STA.
EL. 96.21
70"X 76"
17
EL. 96.93
EL. 80.16
WELLINGTON
56"X 61"
23
16
EL. 93.89
98"X
72"X 80"
24
MEDFORD SQ.
MEDFORD BR. B. & M. RR.
20
53"X 56"
21
HIGH ST.
35
25
EL. 9
PUMPI
EL. 7
EL. 8
EL. 91.70
MYSTIC AVE.
EL. 97.20
22"X 28"
EL. 94.19
EL. 93.03
39"X 48"
26
17"X 2
SOMERVILLE AVE.
27


REVERE
EVERETT
CHELSEA
EAST BOSTON
WINTHROP
CHARLESTOWN
DEER ISLAND
SHIRLEY GUT
LONG ISLAND
MOON ISLAND
WINTHROP BEACH STA.
DEER ISLAND LIGHT
LONG ISLAND LIGHT
BELLE ISLE INLET
BREEDS ISLAND
ORIENT HEIGHTS STA.
B. R. B. & L. R. R.
E. R. R.
W. EVERETT STA.
EVERETT STA.
CHELSEA STA.
MAPLEWOOD
1
2
3
3½
4
5
6
7
8
9
10
11
12
14
15
16
17
17½
23
24
25
26
31
32
35
36
37
38
39
40
76"
109"
109
109"
109"
109"
109"
106"
72" X 120"
72" X 75"
100" X 110"
98" X 106"
70" X 76"
72" X 80"
40" X 45"
36" X 41"
25" X 34"
25" X 34"
19" X 28"
29" X 37"
37" X 44"
39" X 48"
77" X 86"
28"
18"
15
15
15"
12"
12"
PUMPING STA.
PUMPING STA.
PUMPING STA.
EL. 98.05
EL. 99.85
EL. 92.40
EL. 94.84
EL. 74.22
EL. 93.37
EL. 99.44
EL. 82.40
EL. 100.87
EL. 103.46
EL. 100.51
EL. 96.72
EL. 88.59
EL. 89.00
EL. 61.88
EL. 113.20
EL. 93.45
EL. 113.05
EL. 104.20
EL. 103.29
EL. 102.71
EL. 98.88
EL. 102.40
EL. 90.14
EL. 96.61
EL. 71.38
EL. 88.38
EL. 91.70
EL. 94.19
EL. 93.03
EL. 96.21
EL. 98.89
EL. 96.93
EL. 90.16
AVE



WRIGHT & POTTER PTG CO BOSTON.   Geo H Walker & Co Lith Boston



METROPOLITAN SEWERAGE SYSTEMS

PROGRESS TO

SEPTEMBER, 30, 1895.

2000 FT. 0 ½ 1 2 3 MILES

0 1 2 3 4 KILOMETERS

Completed Metropolitan Sewers indicated thus,	▬▬	Contract Sections by figures and letters, thus,	F 23
Metropolitan Sewers under Construction, thus,	▬▬	Diameters by smaller figures, thus,	36"X 41"
Boston Main Drainage Sewers, thus,	- - - -	Elevations by still smaller figures, thus,	EL. 100.33

Elevations are referred to a datum about $100\frac{64}{100}$ feet below mean low water of Boston Harbor.